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WORLD PETROLEUM

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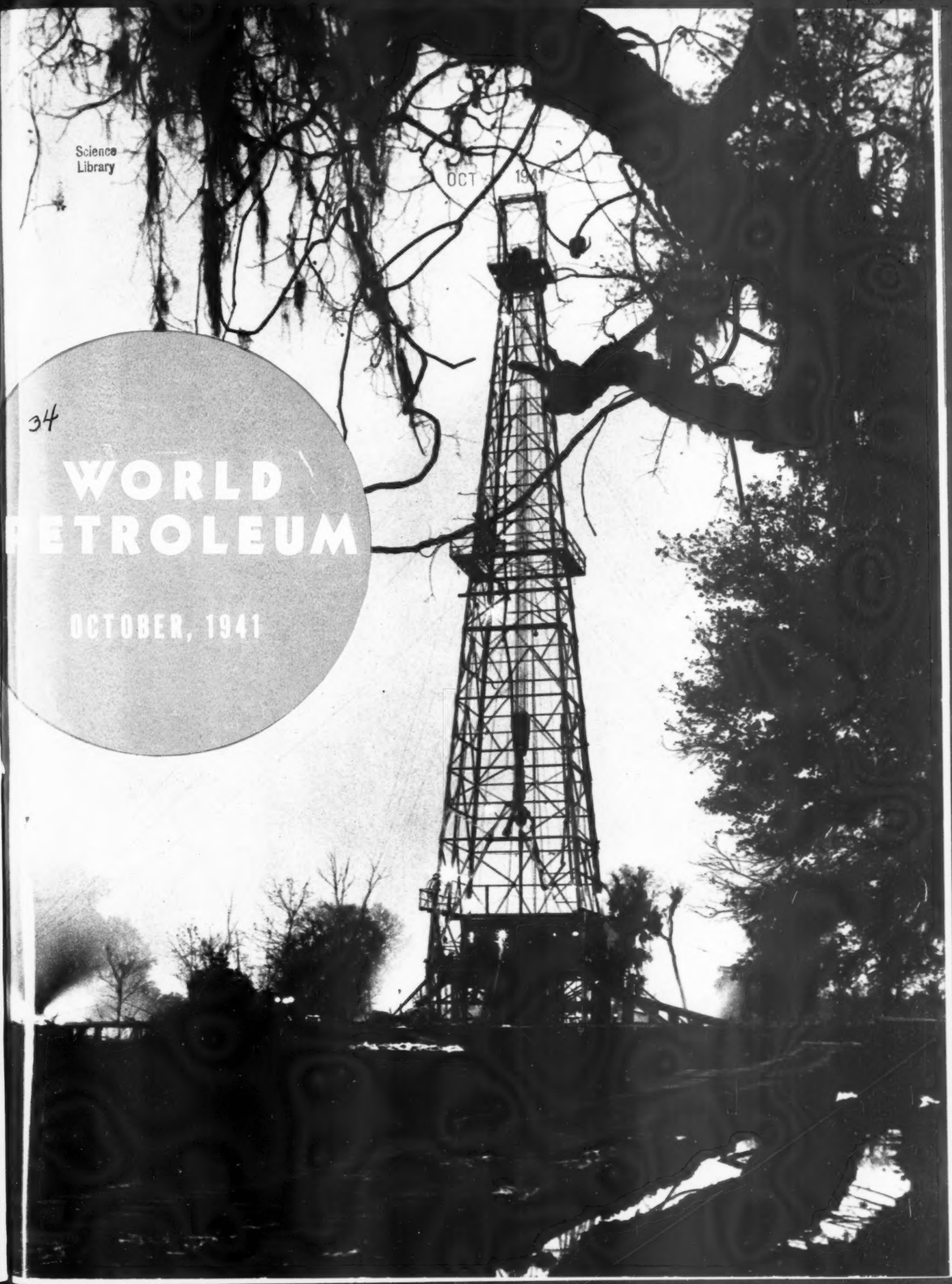

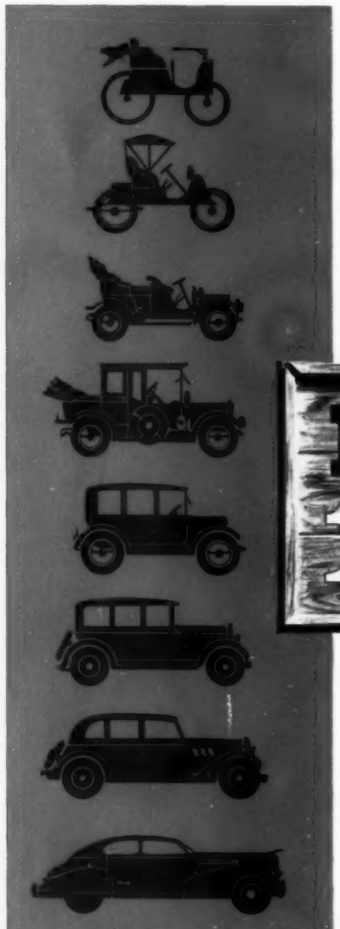

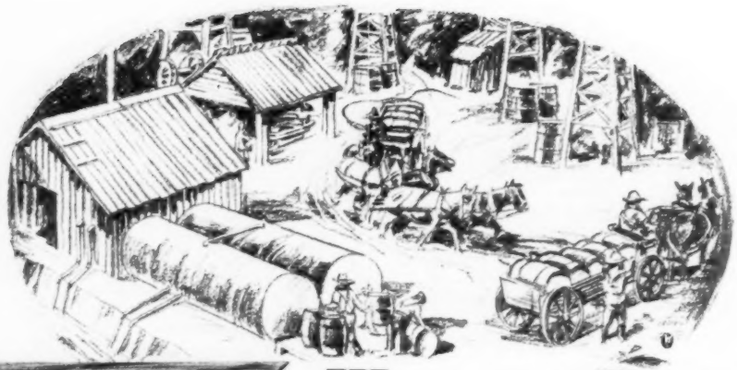

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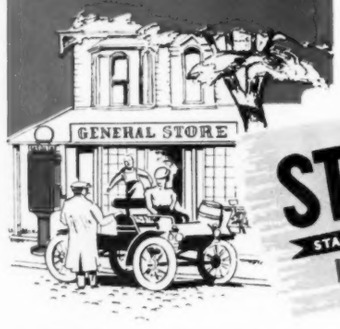

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Large capacity pumping jack operating a well located in the middle of a Mid-Continent tank farm: Photograph, courtesy Frick-Reid Company. The photograph reproduced on the front cover of this issue was taken by Ulric Meisel.

EDITORIAL

OIL INDUSTRY DOING ITS JOB

Conflicting views and policies among the numerous departments, bureaus and administrative agencies in Washington having to do in one way or another with the adjustment of American business to the requirements of a vastly expanded war effort have added greatly to the difficulties of the oil industry in meeting a constantly shifting situation. They have not affected the willingness and determination of the industry to do everything within its power to meet every demand that may be put upon it and to comply with every official request that may be presented regardless of individual views as to the wisdom or efficiency of some of the procedures which it is called upon to adopt.

Back in the early days of the preparedness movement oil men consulted with officials of the Office of Production Management and plans were drawn up for the accummulation of large supplies of liquid fuel at strategic points in the eastern states. That these plans were only partly fulfilled was due to intricacies of government red tape for which the oil industry was in no way responsible. Voluntary offers to expand capacity for the production of specialized products essential to the defense effort were made and construction of a number of plants devoted to such production was put under way without any definite assurance of a market for their output when completed. Demands of the Navy for transfer to its use of tankers employed in the commercial movement of oil were promptly complied with and the companies found other means of filling the deficiency. Oil company pipe line programs adopted early in 1940 to relieve transportation pressure were held back from execution for more than a year by railway opposition which only action by Congress was able to overcome.

When Secretary Ickes was appointed to the post of Petroleum Coordinator the members of the oil fraternity abolished memories of past differences, accepted his leadership and devoted the energies of many of their ablest representatives to collaboration in the working out of plans put forward by the Coordinator. Sinking such divergencies of opinion as existed among themselves they agreed upon an ambitious pipe line enterprise urged by the Coordinator, assigned their engineers to the survey and design of the line and had everything ready for the forward signal when the undertaking was stalled by denial of a priority order for needed materials. Deprived in large part of the cheap and efficient form of transportation on which their marketing operations had been based the eastern oil companies turned to the sixfold more costly method of moving supplies by railway and are pressing into service every obtainable tank car in order to avoid a threatened shortage or at least to lessen the force of its impact. They have done this without reflecting the increased cost in their sales quotations relying upon the promise of Price Administrator Henderson to make an equitable apportionment of the added expense that is being incurred by this change.

In the controversy regarding a predicted shortage of petroleum products in the Atlantic Coast area the oil companies took no part. They observed the Coordinator's instructions in regard to the night closing of service stations and the rationing of distributors and at the same time busied themselves with the practical task of finding and employing every available means to expand the eastward flow of urgently needed products.

In the first world war the task of providing the supplies needed to keep the war machine of the Allies going, as well as to sustain a military effort by the United States vastly greater than the present one, with a minimum of deprivation to the civil population, was entrusted to the oil industry itself with only that degree of official supervision necessitated by the government's vital interest in the whole enterprise. That task was performed successfully and without friction in spite of physical difficulties relatively more serious than those that are faced today. That the present federal administration should have preferred to deal with the problem through the elaborate system of boards and bureaus which it has set up has not been questioned by the oil industry which seeks only to serve with ever increasing efficiency the needs of the country as they are revealed to it.

The instances referred to above, among many that might be cited, are mentioned to show that the oil industry has followed a consistent and patriotic course in keeping its collective mouth shut and devoting its every effort to supplying products where they were needed. Deputy Coordinator Davies, while paying tribute in a recent speech to the fine spirit of cooperation displayed by the industry, chided it gently for not being more vocal in telling its own story. It is not clear that such a course would have been helpful in the babel that has been raised over the oil situation, but it is worth stating for the record that the industry has done and is doing its job despite many obstacles and confusing instructions. Whatever sins of omission or commission have occurred in defense preparations cannot be placed at its door. Should such an attempt be made in future then will be the time for the industry to become vocal indeed.

Ralph K. Davies (left) appears before Senate Commerce Subcommittee to support statements of Coordinator Ickes that rationing is necessary to meet the impending East Coast shortage. Members of the subcommittee are seated on the right and are (l. to r.) W. Lee O'Daniel of Texas, Francis Maloney of Connecticut, Warren Barbour of New Jersey and Harold Barton of Ohio.

Is & Ewing

SPAB RULING STALLS PIPE LINE PLANS

WASHINGTON

CONSIDERABLE clashing of gears has occurred during the past few weeks as a result of conflicting views of different official agencies as to various phases of the national defense problem. While discussions as to the existence or non-existence of an oil shortage on the Atlantic Coast have attracted a great amount of public attention the development that has caused most chagrin around the Interior Department building has been the denial by the Supply Priorities and Allocations Board of a preference rating for steel to be used in construction of the proposed giant pipe line from Texas to the Atlantic Coast. For the time being at least this has put both the Petroleum Coordinator and Leon Henderson, price controller, on the spot, since both had gone on record by declaring that the carrying out of the project was a matter of national necessity.

From the commencement of his service as Coordinator Secretary Ickes has insisted that a shortage of petroleum products impended in the eastern states and that the surest and most satisfactory means of ending this threat to supplies was by the building of pipe lines. The type of line decided upon and the route adopted were those that the Secretary favored. Under his urging eleven large oil companies agreed to participate in financing and building the line and these companies went to great expense in making aerial and surface surveys of the route, preparing engineering plans, and even concluded contracts for construction on the assumption that the line was to be pushed to speedy completion.

Under these circumstances flat refusal by the S P A B to grant a priority rating on the ground that steel was more urgently required for the Army, Navy and shipbuilding needs was a decided setback to the Coordinator and his organization. Messrs. Ickes and Davies still insist that the pipe line is needed and profess confidence that it will be built. In other quarters, however, the view taken is that the time already lost and the impossibility of completing the important eastern section of the line over the Alleghany Mountains before winter sets in deprive the project of any great value in meeting an Atlantic Seaboard emergency which is expected to be relieved by next spring.

The attitude of the Ickes group was set forth by Deputy Ralph K. Davies in an address before the annual meeting of the National Petroleum Association in which he pointed out that all the readjustments thus far accomplished in the overland movements of oil and its products into the east coast region had made up only slightly more than one-half of "the transportation deficiency of over 350,000 barrels a day" created by the lend-lease diversion of tanker tonnage.

Such readjustments, he said, included combinations of barges, pipe lines, pipe line diversions of flow, improved terminal facilities and increased use of motor trucks. Beyond this, he added, the petroleum industry had come forward with a pledge to use whatever tank cars the railroads can make available for the hauling of crude oil and oil products from Texas and the Mid-continent to the east coast.

"Both the Coordinator's office and the petroleum industry," said Mr. Davies, "have seen a large pipe line as the permanent and secure means of solving the east coast transportation problem. Such a line, connecting all the principal sources of crude oil lying east of the Rockies with the eastern centers of concentrated demand, will provide a backbone to which can be joined an emergency and permanent transportation system for oil and its products.

"You cannot sink a pipe line, and it is not subject to the war-time hazards of 2,000 miles of open sea between the Gulf and the East.

"The contracts for such a pipe line have now been completed. They have been signed, sealed and delivered and certainly represent a splendid example of industry-government cooperation to meet an emergency. Actual work on the line awaits only the allocation of necessary priorities. The difficulties here are large, due to material shortages and competing defense demands which grow from day to day. But I still think we may take pride in the progress that has been made on this enormous project and we will hope it will be carried to completion with the same skill and speed as have so far been evident."

Without directly mentioning the hearings of the Maloney committee and the testimony given for the Maritime Commission and by the representatives of the railroads in opposition to the pipe line project Mr. Davies noted that "in all the agitation over the supply situation" the petroleum industry has been "almost completely silent." Referring again by inference to the Maloney committee's report which said that members have not at the present time attempted "to find out whether or not the shortage question arose as the result of a desire to construct a large pipe line or whether behind-the-scenes was the pending anti-trust suit or the price of petroleum, Mr. Davies said:

"It would seem to me, in the circumstances, that a little more vocal participation and a little less silence would go a long way toward enlisting public support and dissipating distrust and suspicion. The industry has a straightforward and interesting story to tell—why not tell it?

"Particularly in connection with the east coast supply situation, you in the industry can be of great assistance in explaining to the public the facts. For you, whose business requires the use of forecasts and estimates, readily understand the danger signals so apparent in a trend. When the demand moves up, and supplies move down, and transportation facilities disappear, you know what to anticipate. Under existing conditions of supplying petroleum to the east, a condition of insufficient stocks constitutes a shortage."

Again referring inferentially to the testimony of Admiral Land, chairman of the Maritime Commission, and Price Administrator Henderson, who insisted that any disclosures as to tanker diversion and the use of tank ships for British or other service of lend-lease supply, could not be given the committee for "military reasons" Mr. Davies added:

"Unfortunately I am prevented from discussing in detail what some day will be regarded as the greatest accomplishment in this joint endeavor in coordinating the petroleum industry for national defense. I refer to what has and will be done in providing oil supplies to those nations whose defense is so vital in keeping the aggressor from our shores. They have been supplied, and well supplied, with that most vital weapon of modern warfare—oil."

It is generally agreed here that Admiral Land's testimony before the Maloney committee, which was presented to S P A B supported by the priority demands of the Navy, was an important factor in inducing that body to deny the formal application of the Petroleum Coordinator for steel for the pipe lines.

"Steel plate," it was announced, "is vitally needed for the construction of ships," and S P A B took the position that it is more important in this emergency to provide for ship construction than to insure plenty of gasoline "for pleasure driving" on the eastern seaboard. The application was for approximately 180,000 tons of steel plate and 190,000 tons of seamless steel tubes. While informing the Petroleum Coordinator's office that the steel plate could not be spared for pipe line construction S P A B indicated that a more favorable attitude might be taken in regard to seamless steel tube as billets from which the tubing is extruded are not in as heavy demand as steel plate. Studies have indicated that it is possible to produce enough tube at least for part of the pipe line project. The Office of Production Management has been requested to determine, whether, if sufficient seamless steel tube is released, the necessary pumps, valves, motors and other accessories can be produced fast enough for use when the tube is ready. S P A B has agreed that if it is found feasible to give priorities for seamless tube to construct the pipe line the situation in regard to steel plate will be reviewed "next spring," and there the matter rests.

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J. J. Pelley, president, American Association of Railroads appears before Maloney Committee to state that sufficient idle tank car capacity is available to make good the deficiency in shipping facilities caused by tanker transfers to British supply service. Senators Maloney and Barbour are shown seated.

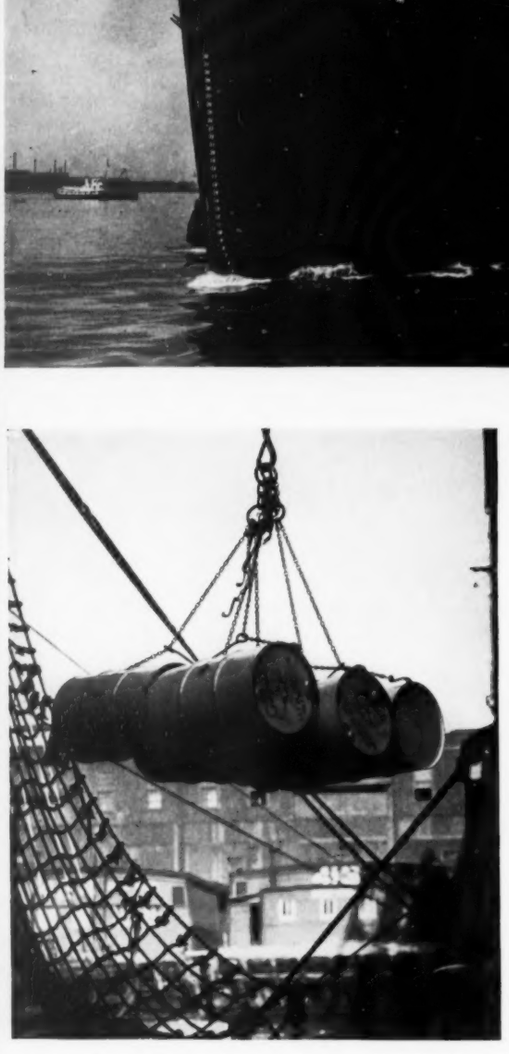
As to the conclusion of the Maloney committee that the only shortage in petroleum products in the eastern states really is a shortage in the "large surplus desired" Coordinator Ickes has taken a stand of "wait and see," combining this with a prediction that those who deny a shortage will be forced to eat their words within the next six months. He fortifies his position by calling attention to figures showing that gasoline stocks on the east coast fell 560,000 bbl. in the week ending Sept. 13 and were about 2,700,000 bbl. or 12½ percent lower than on the corresponding date last year, while demand is 11 percent higher than in 1940.

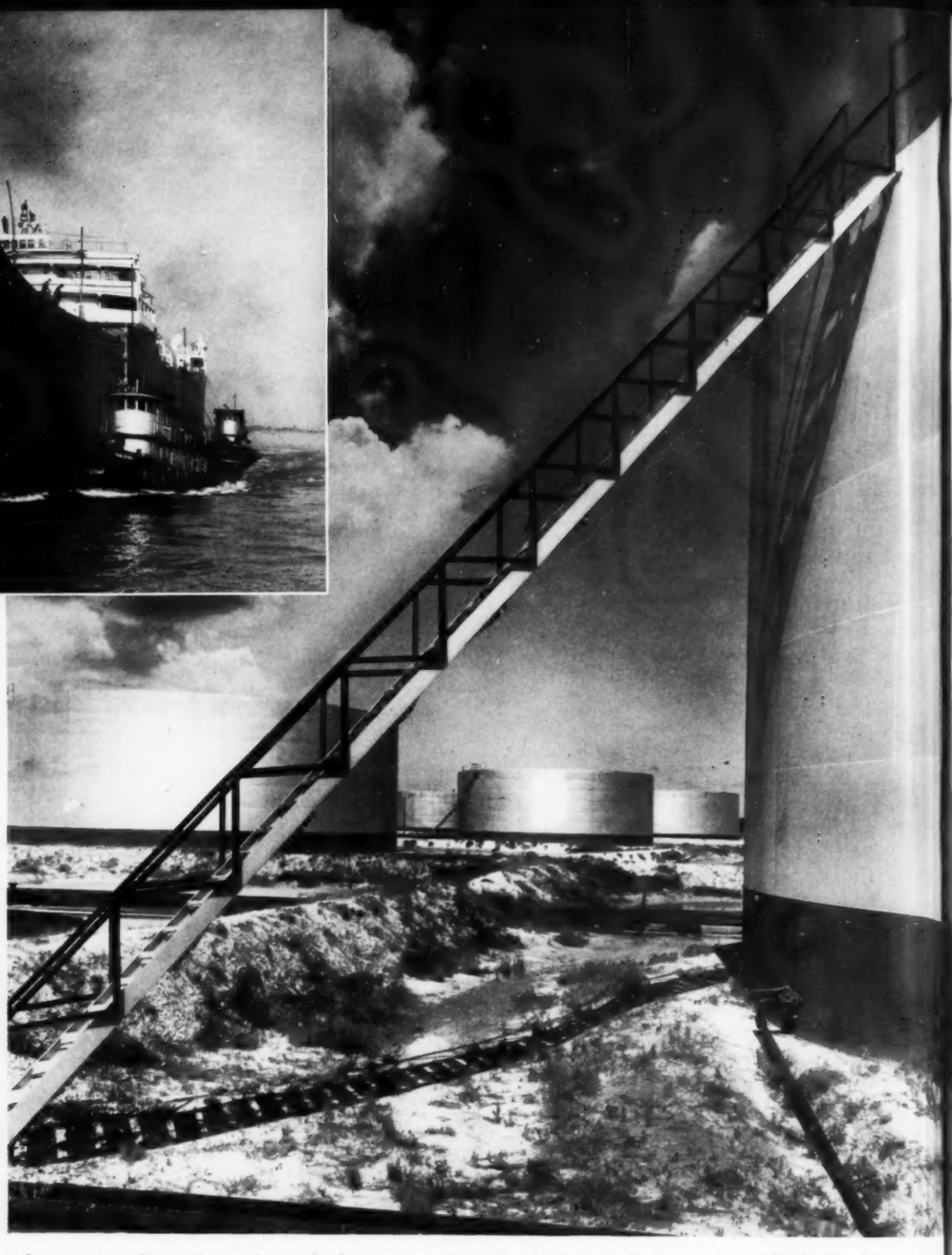
Perusal of the Maloney committee report indicates that the committeemen were strongly impressed by the statements of J. J. Pelley and Ralph Budd as to the ability of the railways to move oil to the seaboard and by the testimony of Admiral Land regarding the outlook for the completion and launching of additional tankers.

Admiral Land told the committee that he had "no enthusiasm whatsoever" for steel going into pipe lines "when needed for emergency and standard type ships." He further asserted that there would be delivered by April 1, 1942, 25 tankers of roundly 400,000 deadweight tons capacity or 2,632,000 barrels. This would be equivalent to 50 of the old type ships.

As for the tank car situation J. J. Pelley, president of the Association of American Railroads, told the committee that studies by railroad representatives showed that there was a total of 153,653 tank cars in the United States on January 1, of which about 125,000 were suitable for moving oil. Qualified experts he said, placed the present surplus of tank cars available for immediate use in transporting oil at about 20,000.

One constructive achievement of the Coordinator's office consists in obtaining a ruling giving an A-10 rating to all replacements and supplies required by oil companies to maintain their operations. Preference Rating Order P-22 eliminates much of the red tape formerly surrounding requests for supplies and requires only that an order for materials shall contain a statement in prescribed form as to its need for immediate use or for emergency inventory. The A-10 rating puts the equipment to which it applies directly after direct defense orders and ahead of all other civilian supplies. The new system, which is now in force, is expected to save much time by obviating the necessity for a special P D order covering each purchase of machinery and supplies. The new order covers twenty essential industries including both the production and refining branches of the oil industry.





Even before the Petroleum Coordinator's Office took steps to relieve the anticipated shortage on the Atlantic Coast, oil companies individually began to increase storage, speed up tanker construction and ship products in case lots to accumulate supplies in the East. Lower left, Ewing Galloway picture; right, Wyatt Metal & Boiler Works photograph.

Should Competitive Distribution Be Suspended During EASTERN SHORTAGE?

By John D. Gill

Economist
The Atlantic Refining Co.

The Question is Raised if Atlantic Coast Shortage Cannot be More Quickly and Effiently Relieved by Competitive Action Than By Government Measures.

WHILE claims and counter claims as to an oil shortage in the Atlantic Coast states have been much in evidence for the past three months it must be conceded that up to the present nobody has been seriously inconvenienced by inability to obtain petroleum products. The fact is that in all particulars save one, the industry is better able to serve the government and its civilian customers than it was, for example, a year ago. It has on hand reserves of crude oil beyond any estimate of near term requirements. Its refining and distribution facilities have been enlarged. On the whole, its transportation facilities are adequate for all expected needs, but for the exception to which I just referred. The industry has lost the use of the equivalent of 80 of its own tankers of 10,000 deadweight tons, averaging a speed of ten knots; it has also lost the use of between 20 and 30 tankers of foreign registry which it has been accustomed to employ; and it must be prepared to lose the service of

Condensed from an address delivered before the Kiwanis Club of Philadelphia.

even more tankers. These losses were occasioned by England's need of tankers. Details of the British situation are unavailable but it is known that, until a few months ago, the loss of tankers in British service was at a rate far beyond their ability to replace them.

There is hardly any question that some of the loss of tankers could have been avoided if Britain had not depended throughout the early part of the war upon its own resources of crude and products in Iraq and Iran in order to save exchange. In view of actual developments it can be seen that this was a mistaken policy but such a conclusion is based upon hindsight and is of little consequence now. Earlier errors have been corrected to a large extent. Today, the Dutch West Indies and the United States are supplying England with virtually all of her petroleum requirements. The commandeered American boats have been put into a shuttle service for bringing products from the American Gulf Coast for transfer to tankers under British control for the hazardous trip across the Atlantic. These tankers have been participating in the so-called Battle of the Atlantic, a battle which probably will be won by the convoy system.

It was not until May of this year that the American oil industry was called upon to turn over 50 of its tankers to this shuttle service. At that time, there were about 261 tankers in the Gulf to Atlantic Seaboard trade. They were more than sufficient for the needs at that time of the year but the loss of 50 tankers could not but be felt. It caused operating companies to set about finding substitute transportation.

The best recent picture of the situation was presented to the Maloney Senate investigating committee last month by Deputy Petroleum Coordinator Davies who had at his disposal the forward picture of each of the companies supplying the East Coast who, in response to a request from the Petroleum Coordinator, had forecast demand and supply with such facilities as were at their command. Mr. Davies stated that in the four months from September 1, the total demand for petroleum along the Atlantic Seaboard would be 199,900,000 bbl. and that anticipated receipts would be 172,100,000 bbl. The difference between the expected demand and the anticipated receipts is 27,800,000 bbl. Inventories along the East Coast amounted to about 72,600,000 bbl. at that time. It is normal to draw upon inventories during the fall and winter months. The usual withdrawal during the last four months of the year is about 6,000,000 bbl. Therefore, the real problem is posed by the difference between the anticipated withdrawal of 27,800,000 bbl. and a normal withdrawal of 6,000,000 bbl. or a possible deficit of something under 22,000,000 bbl. or 174,500 bbl. per day.

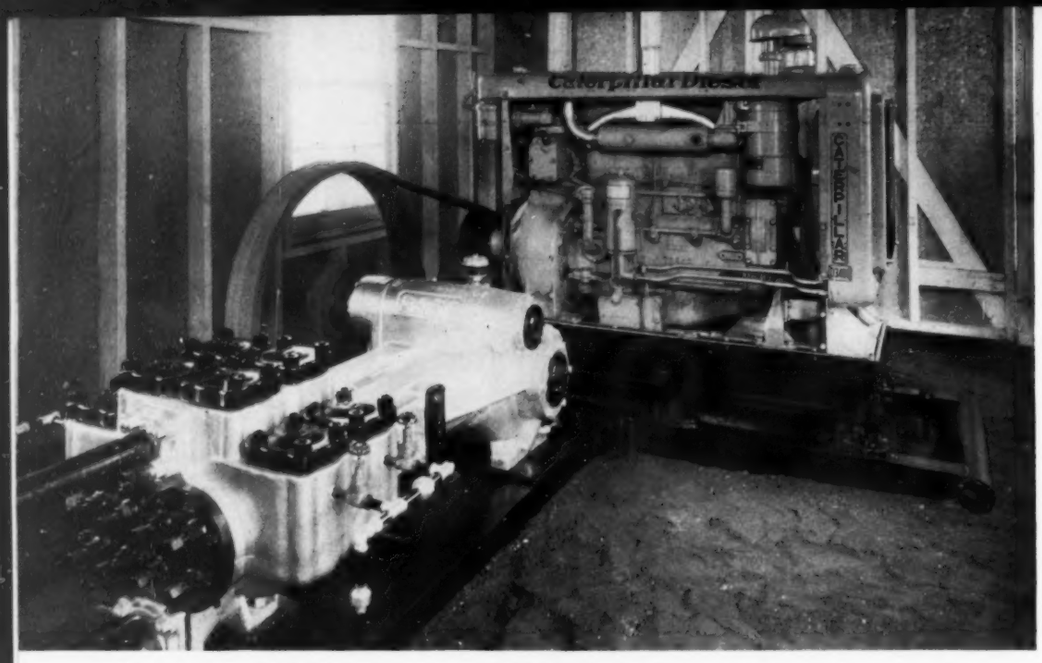
Two facts appear from this resumé. The first is that the apparent deficit, to occur while maintaining inventories at usual levels, is about 10 percent of the total expected demand. The second is that, if there is no additional requisitioning of the industry's tankers and if all other factors remain unchanged, it will be possible to supply all demands by cutting into inventories until they have been reduced from 72,600,000 bbl. to some 44,800,000 bbl. at which level they would contain a reserve estimated at ten days' needs. Such a level of inventories may be too low for safeguarding essential industry. For this reason, the Petroleum Coordinator has instituted a transportation conservation program. Thus far it has operated through gasoline. Any reduction of consumption of any product will obviously leave available that much more transportation for other products. This suggests a partial answer to a question perplexing many consumers as to whether there will be a shortage of oil for home heating during the coming winter.

Barges are being used extensively to ship supplies east via Great Lakes and the New York Barge Canal and other inland waterways. Photograph by Triangle.

There appears to be a basis for reasonable assurance that by concentrating the practice of transportation conservation through motor fuel completely adequate supplies of domestic heating oil and industrial fuel oils will be available, unless some extraordinary event occurs in the near future further to restrict the ability of the industry to move its products to the Atlantic Seaboard.

Aided by results of efforts to relieve the transportation shortage, it is to be noted that even in the case of motor fuel the revised September allocations appeared to be in the nature of an easing of the situation in view of the fact that authorized September deliveries were as large as the August deliveries even though September consumption ordinarily is less than August consumption which represents the summer peak.

Aside from the problem of immediate supplies there are some broad questions growing out of the efforts of the administration to direct the petroleum industry in the affected area through schemes for the pooling of facilities and supplies and for the allocation of available supply of products to distributors and consumers. The future of the American system of free enterprise is not the least of the questions raised by the handling of the present Atlantic Seaboard petroleum demand and supply situation. The subtleties of the situation warrant a careful study of the probable effects of the impact of the regulations and orders upon this system. No doubt throughout the emergency the free enterprise system of doing business, which is one of the most important things that we are seeking to save by our efforts to help England and her Allies, will be subject to many modifications. However, the basic character of the system must be maintained intact if it is to emerge at the end of the war completely



Not only has consideration been given to the construction of cross country trunk pipelines but much actual work has been done in stepping up horsepower in existing pump stations and increasing capacity of smaller but important links in the pipeline system. Photograph by Caterpillar Tractor Company.

reinstated as the system under which this country has grown materially great and under which it may continue so to grow.

In making this statement no criticism is intended of any act of the administration as a whole or of its Petroleum Coordinator with respect to efforts to determine the facts of the oil situation and to prepare for a minimum adverse effect upon industrial and civilian consumers from the withdrawal of tankers in the direct aid of Britain. Regardless of differences of opinion concerning the feasibility of this or that plan, the personnel of the oil industry has worked indefatigably with the Coordinator's office for the prompt fulfillment of requests and for the execution of orders. The industry is continuing to cooperate in every way. The cause of concern, therefore, lies not so much with the immediate effect upon the supply-demand situation of any specific order but rather with the indications which these orders give of the probable effect they would have upon the welfare of our economy if they were to be continued as modifications of our historic method of doing business.

If the free enterprise system of business succumbs to the impact of the modifications which are now being forced upon it the reason will be that not a large enough number of men have clearly thought through the advantages of our system. Some, at times, are half persuaded that socialistic procedures should be given free rein for their early and complete establishment. We have many examples of the efforts, sometimes successful, of this or that block of the working community, like the farm block, to obtain succor from the government almost regardless of the price paid in freedom to exercise initiative and conduct one's affairs according to self-interest so long as the rights of others are not trespassed.

It may be taken for granted that that system of doing business is best which over the long term promotes the maximum production and distribution of the goods and services which our people want. Historically, each individual in America has been free to follow his own interest. This is the exemplification of economic democracy. Although we may not be sure that this system has produced the maximum of goods we are sure that it has brought about a more rapid growth of material welfare than any other system has elsewhere and has provided the nation with the highest per capita income.

Now the taking of tankers from oil companies serving the Atlantic Seaboard in the interest of national defense created a big economic problem of production and distribution. This problem could be solved in part or whole by following either of two economic systems; namely, first, the long-established system of free enterprise by which the companies, after giving up their prorata share of tankers, could act independently, each in the interest of its own business; or, second, some new system for which we do not have an appropriate name but under which the suppliers would be constrained to act only in accord with some general scheme uniformly applicable to all of them. This might be understood to imply a pooling of all facilities and supplies, and operation under a governmental agency.

In this connection it may be pointed out: first, that the measure of the effectiveness of the methods used to solve the problem is the increase in the supply of petroleum due to the initiation of operations to offset the effect of the transfer of tankers to British service; second, that any scheme for the mere pooling of facilities accomplishes little toward increasing the supply; third, that, on the contrary, the pooling of facilities and supplies, which is a system of operation contrary to that we have long worked under, tends to reduce and even cancel the advantages which one or another of the suppliers may have in the competitive situation and thus discourages efforts to achieve the very purpose of increasing the total supply; and, fourth, that so long as there is freedom of action, like that historically enjoyed under the operation of the free enterprise system, for suppliers to exercise initiative and ingenuity and aggressive action in the hope that they may thereby better serve their customers and enjoy the fruits of their effort, there is substantial achievement toward the solution of the problem. This kind of effort is distinguished from the efforts of bureaucracy in several particulars but in this one most of all, namely, that it brings to bear on the problem many trained minds competent to think constructively regarding the possibilities for the solution of the problem as compared to a few minds of doubtful familiarity with the possibilities for solution.

Let us consider how the system of free enterprise has worked up to the present. The initial commandeering of American flag ships took the equivalent of 50 tankers out of the East Coast service. The second demand upon the American fleet took the equivalent of 30 more. These ships represented daily deliveries of about 320,000 bbl. of crude oil and petroleum products, or about 19 percent of the Atlantic Seaboard's daily requirements. Now the units of the industry, working in the usual independent, competitive way, have been installing pipe lines, increasing the throughput in the usual direction of existing crude pipe lines, reversing the direction of flow of others, stepping up the employment of barges on inland waterways, using tank cars for long hauls of crude and products, increasing the speed of loading and unloading of tankers and by exchanges, sales and purchases have thus far reduced the daily shortage represented by the commandeered tankers to 174,000 bbl. daily.

The situation has been further relieved by the repeal of the so-called load line regulation by means of which some tankers have been able to carry upwards of three percent larger cargoes. The load line law is a police type of regulation, more or less arbitrary in nature, though with the admirable objective of reducing the hazards of voyages. It is not, therefore, considered strictly as an economic restriction and may be re-instated at the conclusion of the present emergency.

Statements have been made that some 22,000 additional tank cars are available for further movement of petroleum by rail. If these are available, and undoubtedly a large number are, their employment will be assured by evidence of the administration's willingness to relieve its downward pressure on prices of petroleum products sufficiently to have the higher costs of rail transportation absorbed. The cost of rail movement of crude and products will be approximately three to four times the cost of movement by the usual methods but, if this additional cost is spread over the entire supply, it will mean a very slight additional cost to each consumer. I think there is no question that the consuming public along the Atlantic Seaboard would be much better off to

(Continued on page 41)

Doubled Production of 100 Octane Fuel Called for by

NATIONAL DEFENSE NEEDS

ADAPTATION of oil industry operations to the effective service of national defense and the extension of the fullest possible aid to Britain and her allies was the keynote of discussions before the National Petroleum Association at its annual meeting in Atlantic City, Sept. 17-19. Addresses by Deputy Coordinator Ralph K. Davies, by W. W. Gary, Director of Refining, and H. A. Gilbert, Director of Transportation, of the Petroleum Coordinator's staff, were devoted to an explanation of defense operations and requirements while British representatives explained the needs of their military establishment, particularly for aviation fuel and lubricants. Dr. Gustav Egloff presented a survey of defense chemicals obtainable from petroleum and a session of the lubrication committee of the American Petroleum Institute, held in conjunction with the meeting, considered special problems relating to the production and handling of lubricants.

"Refining is the weapon with which the petroleum industry wins its battles," Mr. Gary told the manufacturing section of the Association in an address in which he emphasized the necessity for doubling the present rate of production of aviation fuel of 100 octane and higher in order to meet the needs of Britain and Russia in addition to the program of the United States.

"It is recognized," said Mr. Gary, "that 100 octane number gasoline is a specialty product and one which, in normal cases, cannot be manufactured profitably without some assurance of an outlet. The need for some sort of financial protection to the refiner against loss of investment is recognized, and plans are being considered with this difficulty very definitely in mind. It is hoped that in the near future it will be possible to make some general announcement of policy with regard to this matter.

"Arrangements already have been made with the Office of Production Management and the Army-Navy Munitions Board to obtain high priority ratings for these plants, thus aiding the prompt and efficient delivery of materials.

"It is appreciated that the manufacture of 100 octane aviation gasoline is to a considerable degree dependent upon the over-all refinery operation. If we are to maintain our present and expanded aviation gasoline output, we must provide the means to keep our refineries running in order to supply the required raw materials for the manufacture of aviation gasoline. Furthermore, our over-all operations must be balanced for all refinery products; hence the source of aviation plan raw materials will be limited. It is therefore essential that all possible sources be carefully considered. Contributions to this program will involve both large and small refiners, and careful consideration will be given each plan that is submitted."

Because of the heavy demands for direct national defense projects, Mr. Gary pointed out, ordinary construction activities may need to be deferred but where such new construction is essential preference ratings may be granted on application. For necessary repairs and replacements priority already is provided.

Asserting that a serious situation exists with regard to the raw materials used in the manufacture of tetraethyl lead Mr. Gary said, "There is a strong possibility that in the near future curtailment of this chemical for civilian use may be necessary. It is appreciated that uniform rationing would result in undue hardship in certain cases. Therefore, in order to plan for the future with regard to this exceedingly complex specification problem, the (regional) refining committees have been requested to appoint temporary sub-committees for study and suggestions to the office of the Coordinator."

Using as his thesis the statement that air power motivated by 100 octane gasoline was destined to play a leading part in winning the war, William Piercy, oil representative of the British government, explained the urgent need of obtaining greatly increased quantities of this fuel from the United States. With such quantities as can be obtained from Trinidad and the Netherlands West Indies this country is the sole available source of supply now that shipments from Iran have been discontinued, Mr. Piercy stated. He revealed that no refining was now being done in the United Kingdom except for the production of limited amounts of asphalt for use on airfields and in road repair and explained that motor fuel for private cars had been cut down to 30 percent of normal consumption while use by commercial vehicles had been reduced 29 percent. On the other hand military needs were constantly rising and would continue to increase with the growth of the air force.

Some grades of lubricating oil were difficult to obtain, Mr. Piercy said, referring to the recent loss of a shipload of lubricants, and he made a special appeal to Pennsylvania refiners to increase lube oil production in view of the preference of the British Navy for Pennsylvania oils. Specifications were being revised, he said, in order to make it easier for American refiners to bid intelligently under them.

Among the war chemicals enumerated by Dr. Egloff as being within the range of supply by the petroleum industry were toluene, synthetic ammonia, ammonium nitrate, glycerine, picric acid, ethyl alcohol, phenol, butadiene and various anaesthetics. While toluene production is being geared to an output of a hundred million gallons per year it is possible that requirements may rise to three or four times this amount. Greatly increased quantities of chemicals entering into high explosives will be called for to provide loads for the large number of fighting planes envisaged by the plane production program and may necessitate a greater concentration of petroleum activities on the production of munitions in addition to the all important 100 octane gasoline.

Enlargement of facilities for the production of synthetic rubber was urged by Dr. Egloff. With consumption of crude rubber proceeding at the rate of 1,000,000 tons a year storage of three months supply with additional quantities en route on the high seas provide an inadequate factor of safety. He pointed out that three processes were available for the production of butadiene and that while plants now in operation or under construction might provide 12 percent of requirements the investment of $500,000,000 in plants to produce a rubber supply would be justified by the scale of other expenditures for defense.

Lord Marley, British government representative, told the oil men of the various measures adopted in Great Britain to adjust the industrial machine to war needs, including the essential work orders system, the concentration of industries movement by which manufacturers in various lines of industry centered operations in the best equipped plants, closing others to be held in reserve, and the virtual elimination of strikes through action of the trades unions which had announced that there should be no interruption of production during the continuation of the war.

To lessen risks from bombing attacks operations formerly centered at one point had been distributed to a number of separate locations and he cited the instance of one large manufacturing concern which now carries on its work in no less than forty-five different locations. The problems of housing, feeding and transport of workers to meet these changing conditions had been worked out in a satisfactory manner, he said.

Deputy Petroleum Coordinator Ralph K. Davies reviewed the work of the Coordinator's office in an address before one of the general sessions of the meeting, in which he paid tribute to the whole hearted cooperation of the industry with official efforts. Mr. Davies reiterated his conviction of the need for construction of the proposed large capacity pipe line from Texas to the Atlantic Coast which is temporarily held up by lack of priorities as the best means of solving the transportation shortage.

One of the simpler stretches of the Portland-Montreal pipe lin e which is being rushed to completion to release tanker capacity for shipment of petroleum and products to the East Coast.

Pipe Lines Helping To Avert Transportation Shortage

ONLY a glance at the pipe line map of the United States is needed to explain the serious effect upon the oil supply of the Atlantic Seaboard of the drastic curtailment in tanker service which has taken place within the past six months. Although the first long distance pipe lines built in the United States were constructed to carry oil from the fields of Western Pennsylvania to tidewater and although pipe lines still convey over 90 percent of all the oil produced in the country on part of all of its journey from well to refinery less than 10 percent of total pipe line mileage lies east of the Appalachians. In the total pipe line mileage of the country, amounting to nearly 150,000 miles at the beginning of the present year, only three eastern states were represented and of these only Pennsylvania possessed a substantial extent of lines, New York and New Jersey figuring in a minor degree through their refinery connections. The combined mileage of the three states was only eight percent of the total for the country. With the centering of large scale production in the mid-continent and on the Gulf Coast and the subsequent construction of large refineries there the convenience and economy of deep water transportation to eastern ports, led inevitably to the adoption of this means of conveyance, both for crude and products. Stiff competition among the marketers of petroleum products made it necessary to employ the cheapest available form of transportation. While pipe lines continued to expand in number and capacity throughout the interior there was no financial justification for extending them to the eastern coast. The cost of ocean transportation was half that of movement by pipe line and continued to decline as tankers grew in size and speed.

Under the stress of this competition eastern pipe lines languished. Some of the lines built originally to move crude from fields in Pennsylvania and Ohio, found new employment in carrying gasoline westward from coast refineries to serve their marketing outlets in east central territory. As a result of this change only two important lines remained as conveyors of crude to the Atlantic Coast. The tanker movement rose with the growth of demand in the eastern area until

Left, before the Atlantic Coast shortage had become acute several companies had already taken steps, such as this Fall River to Waltham line built by Shell last winter, to improve transportation facilities. Below, welders joining sections of the Portland-Montreal line.

upward of 1,250,000 bbl. were being delivered daily to eastern refineries and distributing stations by this means, about 95 percent of shipments east taking the water route.

Withdrawal of roundly 20 percent of these tankers early in the summer to reenforce the movement of oil supplies to the United Kingdom followed by the subsequent division of another 10 percent or approximately 80 vessels altogether, combined with the loss of foreign flag tonnage formerly serving the Atlantic Coast, threatened a serious disruption in the provision of supplies essential to the industrial and commercial activities of the eastern states. A survey of the situation by a fact finding committee of the American Petroleum Institute during May last, indicated a probable shortage of 374,000,000 bbl. in East Coast supplies during the ensuing nine months, with the heaviest deficit occurring in the final quarter of 1941. In the face of this disturbing prospect the oil companies serving eastern territory, in cooperation with representatives of the newly appointed Petroleum Coordinator, set about devising means to relieve the situation.

As the first and most promising method of replacing the flow of oil shut off by tanker withdrawals attention naturally was directed to the enlargement of pipe line facilities since pipe lines

provide the most rapid means of moving oil in quantity, are next to tankers the most economical and are by all odds the most dependable. Three possible methods of increasing the eastward pipe line movement presented themselves. These were (1) the reversal of flow in lines employed in transporting products in a westerly direction from seaboard refineries so that they would be bringing crude oil eastward instead; (2) employing unused capacity of crude lines east and west of the Mississippi in conjunction with tank car movement from their eastern terminals, and (3) the construction of entirely new lines or enlarging the capacity of existing lines by looping.

Building of new pipe lines requires time under the most favorable circumstances, though improved methods and equipment enable construction to move at an amazingly rapid pace. First attention therefore, was directed, naturally enough, to the utilization of existing facilities. In this direction substantial gains were made at an early date. Standard Oil Company of New Jersey, for example, by suspending the movement of crude oil from Philadelphia to Sarnia, Canada, and making this line available for eastbound crude, by reversing the direction of flow in its Tuscarora line and devoting this line to the eastward movement of crude, and by making larger deliveries to terminals of other lines at Lima and at Martinsville on the Ohio River for forwarding by tank car, has raised its eastward movement of crude by approximately 34,000 bbl. daily which is equivalent to the replacement of eight to ten tankers. Tidewater Associated, which operates the oldest through crude line in the east, has raised the capacity of the line and is now transporting 3,500 bbl. daily by pipe line from Texas and the Mid-continent to New York. Atlantic Refining Company, Sinclair Refining Company and Cities Service Co., by calling into service pipe line capacity not previously in use, or through the combination of pipe line and tank car shipment, have raised their daily receipts of crude at eastern points by between 17,000 and 18,000 bbl. Other companies, either through lines of their own or through arrangements with the operators of other lines, have provided for a certain proportion of their receipts through this means. Altogether pipe line facilities brought into play without new construction except for short connecting and terminal lines have reduced the deficit in transportation by an amount equivalent to nearly half the number of tankers actually withdrawn. According to the statement of Deputy Coordinator Davies before the Maloney Committee of inquiry, the Bureau of Mines estimate of Atlantic Coast requirements of petroleum products during the final four months of 1940 was 199,000,000 bbl. against estimated receipts of 172,100,000 bbl. leaving the actual transportation deficit 27,800,000 bbl.

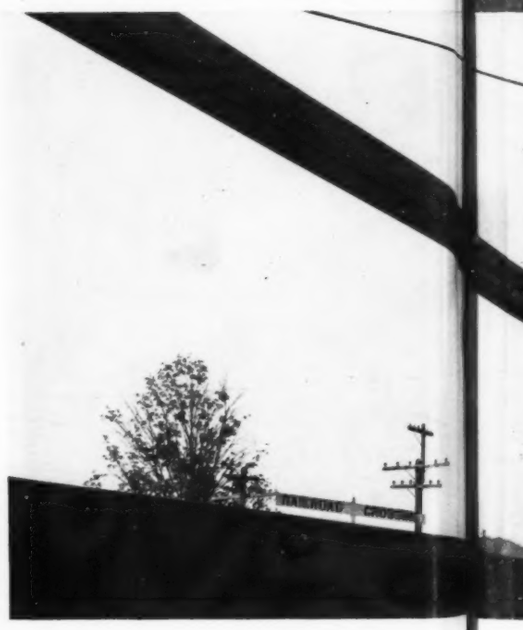
In the construction of new pipe lines several factors have intervened to delay the progress that was anticipated several months ago and possibly to prevent the carrying out of the most ambitious of the plans then put forward. Most important of these factors has been the rapidly expanding scope of the direct war effort, demanding greatly increased quantities of steel and other metals and necessitating the tightening up of priorities affecting these products. After consideration of various suggested lines for the transportation both of crude and refined products and consultation with the oil companies that logically would be the principal users of such lines, Petroleum Coordinator Ickes approved the plan for a system 1,586 miles in length to extend from Longview, Texas, to the refining centers on the Atlantic seaboard at Philadelphia and New York.

The oil companies concerned in the undertaking set up an engineering organization which proceeded with an aerial survey of the route, selected sites for construction and operating stations and even went to the extent of inviting bids for construction to be submitted on August 27. These were withdrawn, however, when the necessary order certifying that the line was essential to national defense was not forthcoming. At a meeting on September 9 the Supply Priorities and Allocations Board denied the request of the Petroleum Coordinator for a priority order covering 480,000 tons of sheet steel for the pipe to be used in the line, basing its refusal on the ground that the steel was more urgently required to meet the needs of the Army and Navy including ship construction. At a subsequent meeting the Board intimated that it might authorize the use of seamless tubing for the line if other requisites in the form of pumps, engines, valves and other accessories could be produced in time. In oil industry circles it is considered that the delay already incurred will make it impossible to complete the eastern section of the line, extending over the Appalachian range, before winter as had been planned and that the whole project has been set back to an extent that makes its completion of doubtful value in meeting the present emergency. The Petroleum Coordinator and his advisors still insist that the line is needed and that means for its construction should be found. As an alternative proposal the building of the western section of the line is being advocated in certain quarters but the outlook for the project as a whole is considered extremely doubtful at the time this is written.

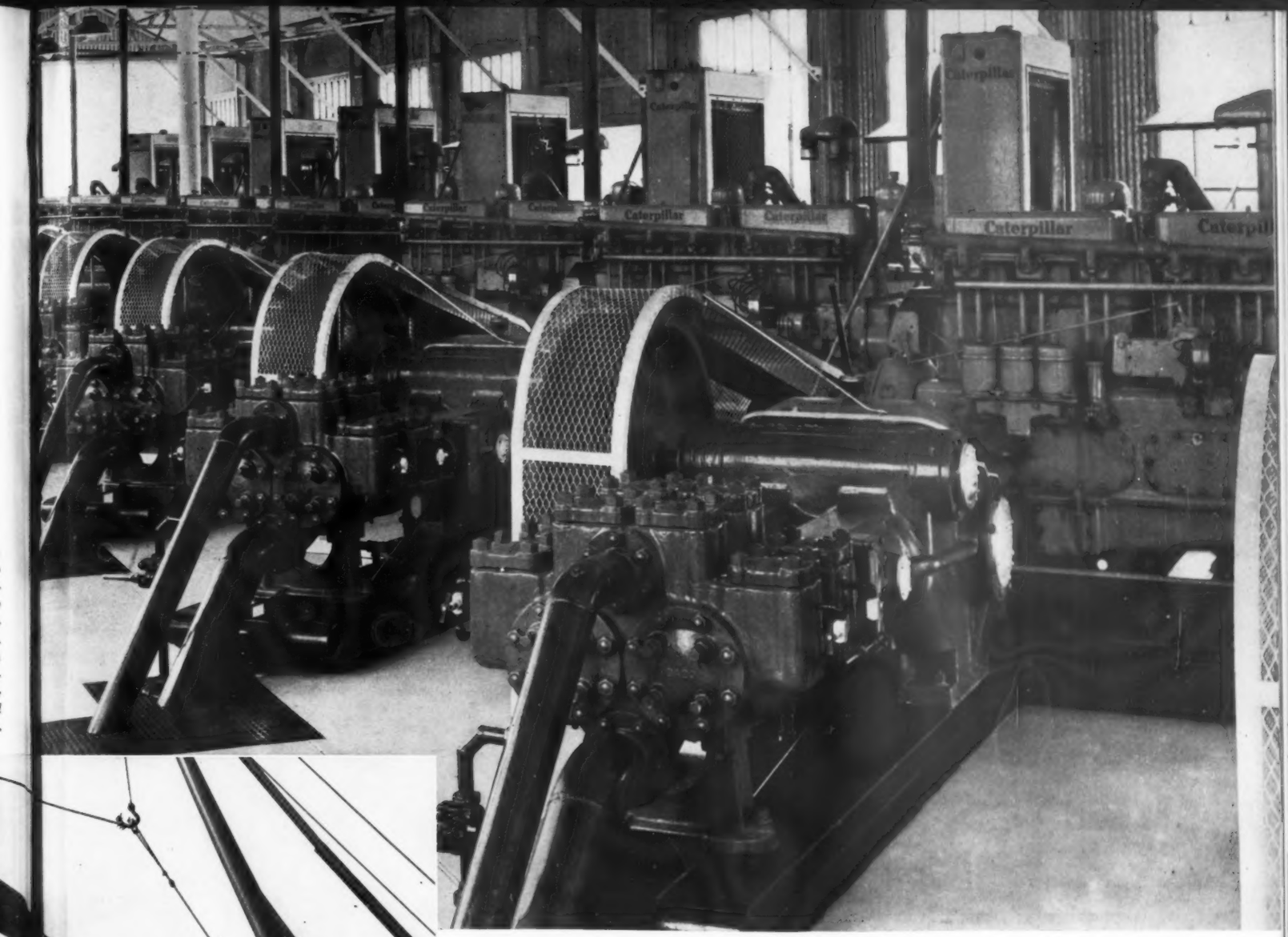
Meanwhile steady progress is being made on three privately projected lines which will be of substantial value in relieving pressure upon tanker transportation. The largest of these is the line of the Plantation Pipe Line Company, extending from Baton Rouge, Louisiana, to Greensboro, North Carolina, a distance of 1,261 miles, with connections extending to Columbus and Macon, Ga., and Chattanooga and Knoxville, Tennessee. The line will be of 12-in. diameter throughout its main stem while laterals will be of 4-in. and 6-in. size. The cost is estimated at $20,000,000 and the company building it is owned jointly by Standard Oil Company of New Jersey, Shell Oil Company and Standard Oil Company of Kentucky. Its planned capacity of 60,000 bbl. daily can be increased to 90,000 bbl. it is stated by installation of intermediate pumping stations. The section to be served by this line has been entirely without pipe line facilities heretofore and it is estimated that its construction will release eight to ten tankers formerly required to service this area.

Survey of the route of this line has been in progress during the past year and orders for the 123,000 tons of steel pipe required for it were placed early in the year with deliveries beginning in July and to be completed in October. Actual construction began in September with stringing of pipe along the route in both directions from the various state lines which it crosses. Under the original plans it was expected that the laying of the pipe could be completed in four and a half months and it is believed that this schedule will be closely adhered to so that the line can be put into service delivering products early in 1942.

Multiple pumping units in a modern pipeline pump station utilizing the principle of a number of low horsepower, high speed engines to move 62,000 bbl. per day through a ten inch line. Below, pipe being delivered to the Portland-Montreal line which will be completed this winter.



Plantation Pipe Line will handle petroleum products. It will have fourteen pump stations operated by electric power, each with three 1,250 h.p. motors and centrifugal pumps. Sixteen terminals with storage capacity well over a million bbls. will be constructed in the various marketing centres served by the line by the three owning companies and tanks with a storage capacity of half a million bbl. will be erected at strategic


Caterpillar
Caterpillar
Caterpillar

The new loading rack at Bayway refinery recently completed by Jersey Standard now handles 80 cars a day delivering 16,000 bbl. and may be called upon to handle 200 cars before the end of the year.

Industry's Program of EMERGENCY TRANSPORTATION

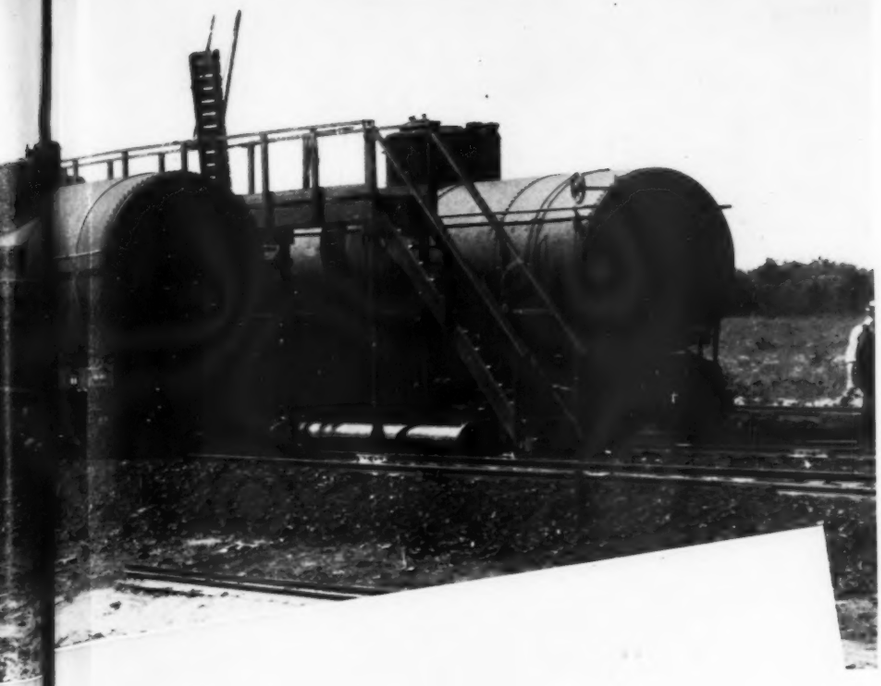
While Coordinator and S P A B Battle Over Pipeline Construction

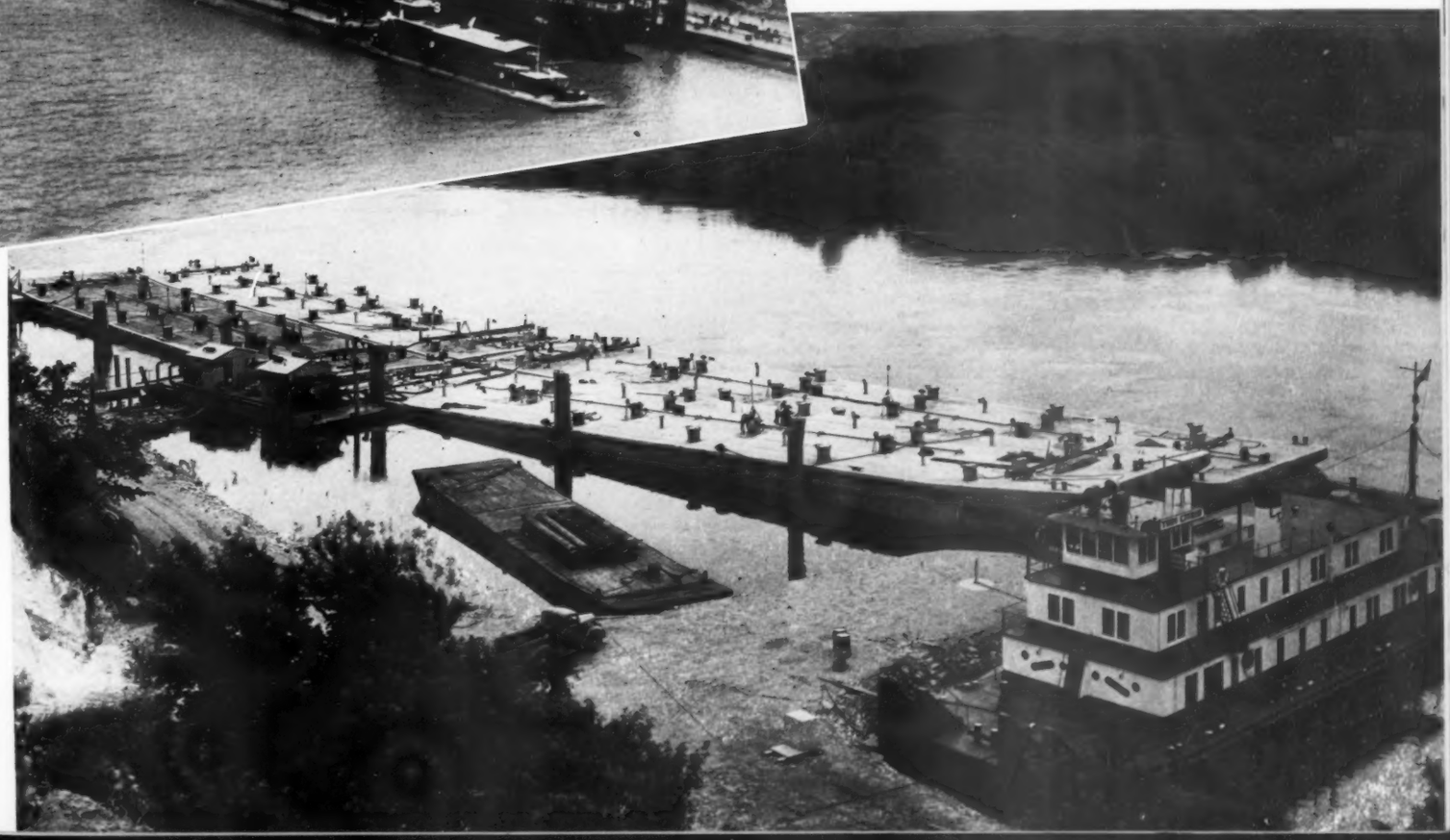
East Coast Oil Companies Utilize Railroads, Rivers and Lakes to Rush Supplies to Atlantic Seaboard

WHETHER the Atlantic Seaboard shortage is merely a deficiency in the surplus that might be deemed desirable, as Senator Maloney maintained after completing his investigation, or whether it may be expected to assume the serious proportions outlined by Petroleum Coordinator Ickes in his frequent statements, the oil companies serving this important consuming center have taken steps to adopt every available alternate means of transportation in order to insure a continuing flow of gasoline and distillate fuel oil to the East. Such steps have included the construction of loading facilities for tankers and tank cars, increasing the capacity of such facilities already in existence, the use of combinations of tank cars and pipelines, or tank cars and barges, the use of tank cars exclusively and the construction of additional storage. Many of the most effective steps taken by the companies to meet the abnormal situation created by the transfer of tankers to British supply service, were initiated and in some cases completed before the Petroleum Coordinator's office got under way.

The date of recommendation No. 5 by the Petroleum Coordinator to the general committee, the refining committee, the transportation committee and the marketing committee of district No. 1 was August 18, 1941. Paragraph No. 2 of the recommendation stated: "That said committees encourage by communication with companies and persons the use of barges, tank cars, pipe lines and trucks as a substitute for the cheaper transportation eliminated by the withdrawal of tankers." The foregoing is of interest in view of the steps that had already been taken along these lines by the companies on their own initiative prior to this recommendation.

It has been estimated by Ralph K. Davies, Deputy Petroleum Coordinator, that the net deficiency in transportation to the East Coast for the last four months of 1941 would be 174,500 bbl. per day. This was taking into account certain quantities to be moved by what may be referred to as emergency methods of transportation. It contemplated the movement of 60,000 bbl. per day additional by the remaining tanker fleet as a result of load line changes and increased efficiency; 20,000 bbl. per day by pipe lines; 10,000 bbl. per day by barges; 15,000 bbl. per day by truck; and 73,700 bbl. per day by tank car. Thus a total of 178,700 bbl. per day would be moved by emergency methods and this quantity subtracted from an estimated deficit of 353,000



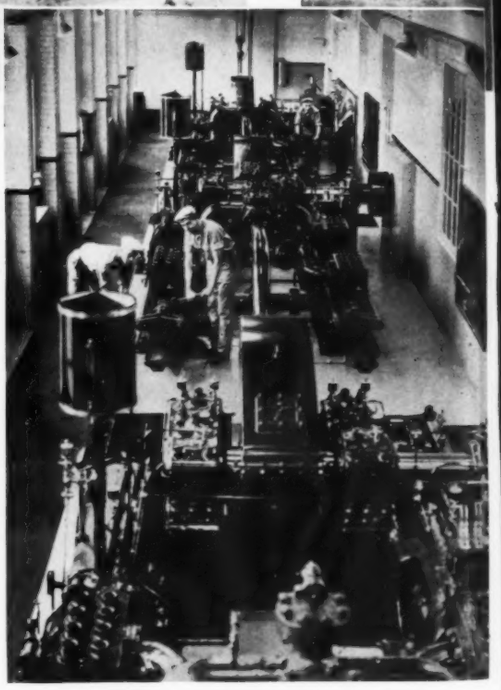


bbl. per day would leave a deficit of 174,500 bbl. per day. Some of the principal suppliers of the East Coast area had already taken the following steps to reduce the 353,000 bbl. per day deficiency to even less than 174,500 bbl. per day.

Shell Oil Company, for example has no refining facilities on the East Coast, and has to rely almost entirely on emergency shipment of products from Wood River, Ill. and Gulf refineries to the East. Already the company has arranged to cover 18 percent of its East Coast requirements by emergency methods and anticipates that before the end of the year it will be supplying up to 25 percent of these requirements by methods other than the normal tanker shipments. It must be taken into account that these shipments increase the cost of transportation by as much as six times normal transportation costs.

The company has also effected savings in tanker capacity, not included in the foregoing percentage figures, by the use of barges where possible in the Gulf Coast area and on the Atlantic Coast in substitution for tankers; by suspending tanker shipments to Shell of Canada and routing these supplies by pipe line and lake barge from Illinois; by tank car shipment to northern Mid-Continent states from the company's Houston refinery, releasing Wood River products to supply the East; and by shipping some crude to other companies' eastern refineries in return for products manufactured by these and affiliated refineries.

Left, Drestrehan 25 miles north of New Orleans where the Socony-Vacuum tanker Astral is discharging 120,000 bbl. of gasoline brought from the company's Beaumont refinery. The cargo will be carried up the Mississippi in the articulated barges shown in the picture and distributed from Pittsburgh or shipped East in tank cars. Below Shell's towboat Twin Cities tied up at Shell's St. Paul marine terminal. Barges and tank cars are taking up much of the deficiency in eastward shipping capacity.



Above, a Shell pipeline from Fall River to Waltham built last winter before the outlines of the transportation emergency had clearly emerged. Right, interior of a pump station on the Shell pipeline at Wood River.

The main problem for Shell is, however, the shipment to the East of refined products from the New Orleans and Houston refineries, without the use of tankers. First, distributing areas have been pushed east so that now some areas in West Virginia, for instance, formerly supplied from the East Coast are now supplied from Wood River. Second, products are shipped by river barge from New Orleans to St. Louis where they are joined by Wood River products for shipment via two Shell pipe lines to Chicago and Toledo. At these points products are transhipped via Great Lakes tankers to Buffalo and then distributed through New York and New England by means of the New York State Barge Canal. Chicago and Toledo also have become distributing centers for the areas east of those terminals. Aviation fuel for Canada which formerly went through New York is now shipped from Chicago. Some all-rail shipments are being made with more expected for the immediate future, the longest all-rail haul being from Houston to Maine. This of course gives rise to a complicated situation as for example when a storage depot has facilities to handle only four or five days supply and formerly was able to reorder on a two day delivery basis: with a ten day or longer rail trip, it is necessary for such depots to reorder far in advance. Since Shell had taken steps several months before the present emergency to increase efficiency in loading and unloading products it has not been necessary to construct any new facilities of this kind as yet. Also recent completion of 880,000 bbl. of storage capacity in the East relieved the company of the necessity, at least for the moment, of constructing additional storage.

Standard Oil Company of New Jersey has laid out a program, now well under way, by which it is expected that 60,000 bbl. per day of crude and refined products can be delivered to the East Coast by emergency methods of transportation. The cost of such transportation is at best more than double the normal tanker rate and ranges to several times that basic figure. Approximately 22,000 bbl. per day of crude is moving into Bayway by pipe line. An additional 22,000 bbl. per day is being moved to Lima, Ohio and Martinsville, Ill. by pipe line and then shipped to Bayway by rail, using 1315 tank cars. A new large capacity loading rack has been constructed to accommodate the frequent arrival of trains of tank cars. Further tank car shipments have been arranged from the Illinois fields and even longer hauls from Texas to the East Coast. Tank cars are being more widely used by Jersey for distribution out of Baton Rouge, releasing tankers and barges for shipments eastward. Barges are used primarily for shipments from Baton Rouge to points on the Ohio River and to a lesser extent from Baytown to Baton Rouge, and from New York to Albany where tankers were used prior to the emergency. In addition to barges and tank cars and to the Plantation and Portland pipe lines discussed elsewhere in this issue, Jersey has extensively rearranged distribution to effect substantial savings in tanker capacity. Thus 10,000 bbl. a day of Venezuelan crude formerly shipped by tanker to Marcus Hook for pipe line transport to Sarnia has been replaced by pipe line shipments from the Mid-Continent and Illinois. Efforts are being made to replace California fuel oil shipments to Chile by supplies drawn from Peru for a net saving of four and a

Wrapping a section of the Southeastern Pipeline which is expected to deliver gasoline to Atlanta by mid-November. The line has now been stepped up to handle 30,000 bbl. per day and temporary pump stations are being located at South Albany, Americus, Macon, Griffin, Atlanta, Euharlee, Summerville and Marshallville, Georgia.

half, 10,000 dwt., tankships. Caribbean markets, formerly supplied from the U. S. Gulf now obtain their petroleum products from Jersey's Aruba refinery in the West Indies. Finally, about 1,000,000 bbl. per year have been diverted from Montreal to Sarnia so as to use crude delivered into Sarnia by pipe line instead of crude from Montreal by tanker. The Bayway refinery has switched from oil fuel to coal and has persuaded Consolidated Edison and other important customers to make the same switch, thereby reducing demand for industrial fuel oil.

Several weeks before Recommendation No. 5 quoted at the beginning of this article had been promulgated, Socony-Vacuum had completed careful studies to determine what changes would be necessary for maximum utilization of tank cars and other emergency means of transportation. As a result of these studies plans are now under way looking to shipment East of between 5,000 and 10,000 bbl. per day entirely by tank car. Purchases in Group 3 market are being distributed in the area normally supplied by Socony-Vacuum's Chicago refinery releasing the output of this plant for shipment East by Great Lakes tanker to the extent of 3,000 bbl. per day. Also shipments by tank car direct from Oklahoma to Paulsboro account for a further 3,000 bbl. per day and required the construction of additional loading facilities at a number of points in the Mid-Continent producing fields.

Early in June Socony-Vacuum started shipments by articulated barge from the Gulf to Pittsburgh and for this purpose transferred two tow boats to the Gulf-Pittsburgh route capable of delivering 3,500 bbl. per day. It is expected that a third tow boat will be transferred to this service shortly. Shipments originating in the company's Beaumont refinery are transported to Drestrehan, north of New Orleans, partly by tanker and partly by barge through the Intercoastal Canal. From Pittsburgh products are distributed direct and are also conveyed in tank cars to the company's Atlantic coast distribution centers.

As far back as last May, Socony-Vacuum started delivering crude via Buffalo, through the New York State Barge Canal and the Hudson River to the company's Brooklyn refinery. Deliveries to Albany by tanker have been entirely replaced by the use of barges and, like all the companies in the East, Socony-Vacuum has arranged to receive tank car deliveries 24 hours a day, seven days a week; has increased unloading facilities for tankers and increased the efficiency of these vessels to the greatest possible extent. When the entire program of emergency shipments is completed Socony-Vacuum will be shipping between 27,000 and 32,000 bbl. per day by these extraordinary means.

The above examples are typical of arrangements which have been made by practically every company serving the Atlantic Seaboard in order to supply needed products with a minimum of disturbance or interruption. Space does not permit a description of the methods adopted by all companies but a few examples may be mentioned.

Atlantic Refining has arranged for shipment of 10,000 bbl. per day from Illinois by tank car and to facilitate this movement has constructed a new rack equipped with a collecting system and pumps capable of handling 50 cars simultaneously. A new marine terminal has been constructed at Fort Mifflin at a cost of $1,500,000 to remove the necessity for tankers to navigate the Schuylkill River to Point Breeze.

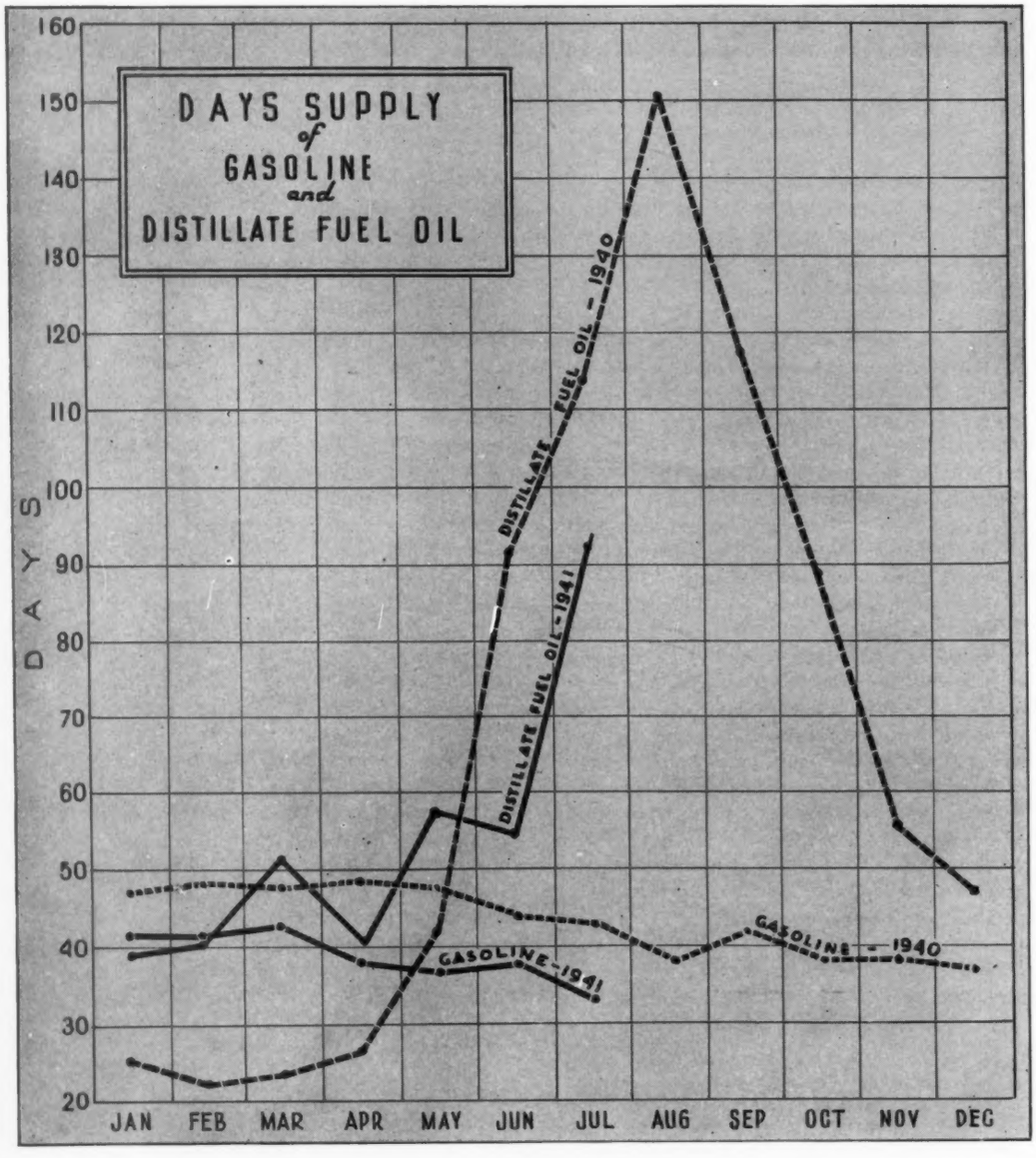
Cities Service has also completed arrangements for tank car shipment of crude from Illinois to the company's refinery at Petty's Island near Philadelphia and to their East Braintree, Mass., plant. These shipments will amount to at least 6,000 bbl. per day. Pan-American is barging oil from the Gulf to Pittsburgh, increasing the efficiency of shipping facilities and utilizing tank cars for shipments formerly handled by tankships. Practically every important oil company serving the eastern area has put into effect plans designed to relieve the transportation deficiency created by the transfer of tankers from the Gulf-Atlantic trade to British supply. It is obvious that steps now being taken in this direction will exceed the figures anticipated by Mr. Davies.

B of M Figures Support Possibility of

EASTERN GASOLINE SHORTAGE

SPECTACULAR interpretations of incomplete statistics gave rise to considerable alarm in regard to the position of gasoline and distillate fuel oil stocks on the East Coast earlier in the summer. More recently the report of the Senate Committee headed by Francis T. Maloney investigating the alleged shortage tended to erase this impression and perhaps to create a feeling of over-confidence in the supply position. The quantity of gasoline and distillate fuel oil stocks available on the Atlantic Seaboard can only be considered in relation to the demand for these products and with reference to available means of bringing in new supplies from the Gulf coast and Mid-Continent to the consuming centers.

Reproduced herewith are five charts based on figures issued by the Bureau of Mines and the American Petroleum Institute as applied to the East Coast only. An examination of these charts reveals that gasoline storage on the East Coast has followed the trend of the previous year although such storage has been noticeably below the corresponding dates of the earlier period. At the beginning of 1941 gasoline storage on the Atlantic Seaboard was about 4.45 percent below the figure for the beginning of 1940; during February, the 1941 figure exceeded that of 1940; since that time it has followed the 1940 trend, but has run between three and 13 percent below the previous year. It should be remembered, however, that gasoline storage for 1940 was generally considered excessive; authoritative statements were issued calling for a reduction in stocks of gasoline to relieve uneconomic pressure on the market structure. On the other hand it should also be borne in mind that demand for gasoline in 1941 greatly exceeds that of 1940 so that heavier stocks would be amply justified. It might be concluded in this respect that stocks about equal to those of 1940 would be consistent with the circumstances of increased consumption.

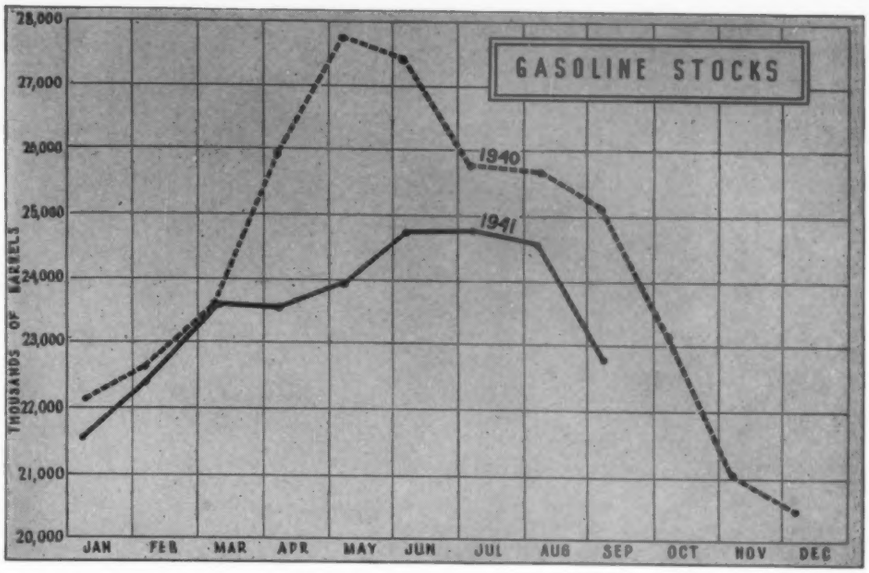


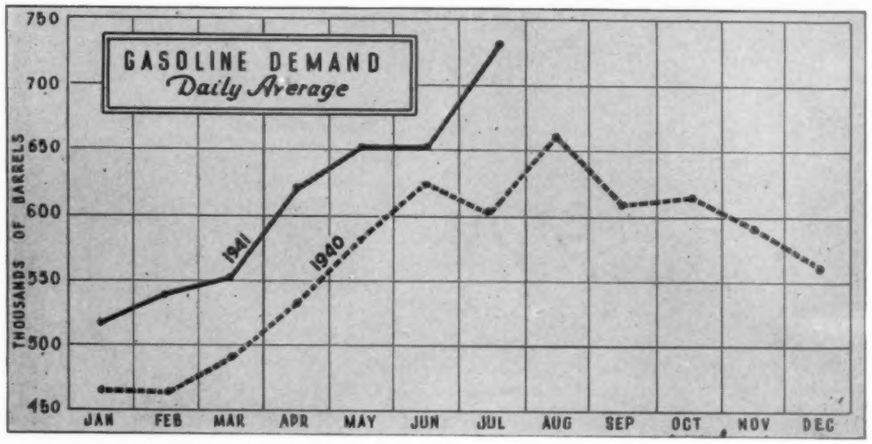
Turning to the chart showing trend of distillate fuel oil storage on the East Coast it may be noted that here again the trend follows the 1940 curve closely but that until June of this year distillate fuel oil stocks on the East Coast exceeded those of the corresponding date of the previous year; during June stocks fell below the 1940 level and have remained slightly below ever since. Starting in January at 76.86 percent above the 1940 figure, the difference in stocks was gradually reduced until they reached a point only 7.55 percent above the 1940 figure at the beginning of June; in July stocks of distillate fuel oil on the Atlantic Seaboard were 7.01 percent below those of 1940 and have since remained about this distance below the figures for corresponding dates of the preceding year. Unlike gasoline demand, however, the demand for distillate fuel oil has been below that of 1940 for the first half of this year, has since run slightly above, probably due to advance ordering by distributors and consumers. It will be recalled that 1939-40 was a severe winter and consumption of distillate fuel oil is extremely sensitive to variations in temperature. As has been pointed out, each drop of one degree in temperature can increase consumption by hundreds of thousands of barrels a day. The storage situation therefore, is likely to become serious only if and to the extent that the winter proves more severe than the previous heating season.

Analysis of East Coast gasoline demand indicates similar trends in 1941 and 1940 with two important differences: First, demand appears to have run almost 12 percent ahead of 1940 for the first half of the year; and secondly, there is reason to suppose that this increase in demand has become substantially larger in the latter part of the summer during the months not covered by the chart. The beginning of this trend is suggested by the chart and will probably be confirmed when figures for August and September are available. The wide divergence, in excess of 21 per cent, in East Coast daily demand figures for the month of July, may have been caused in part by stocking up of retail outlets and rural consumers. Perhaps 12 to 14 per cent of the increased demand is accounted for by actual increased automobile driving, the balance being due to abnormal causes such as the wide publicity given to forecasts of an impending shortage. East Coast distillate fuel oil demand follows a more stable trend, the only notable deviation being the sharp upturn in June of this year which may be accounted for in part by the beginning of the publicity campaign emanating from Washington in regard to an East Coast shortage. Such a jump in demand at the very end of the heating season when the temperature in the Atlantic area was unusually mild, definitely in-

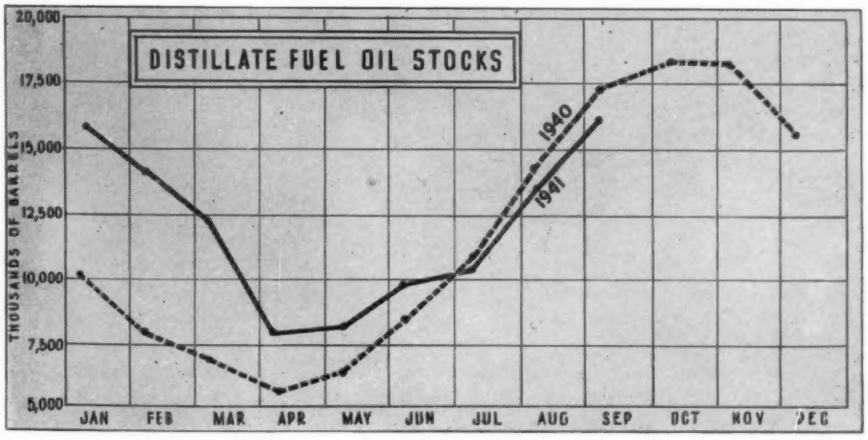
dicates abnormal stimulus. The trend appears to be returning to normal during July and there is every indication that it will not greatly exceed that of 1940 unless the winter proves unusual. Considered in relation to stocks which appear about normal for the East, it may be assumed that domestic heating supplies present at this time considerably less of a problem than do gasoline supplies although this situation may change later on should the winter prove severe.

The problem of demand and supply may be studied to best advantage in the chart showing days supply of gasoline and distillate fuel oil for 1941 as compared with 1940 for the East Coast only. This chart appears on the facing page.



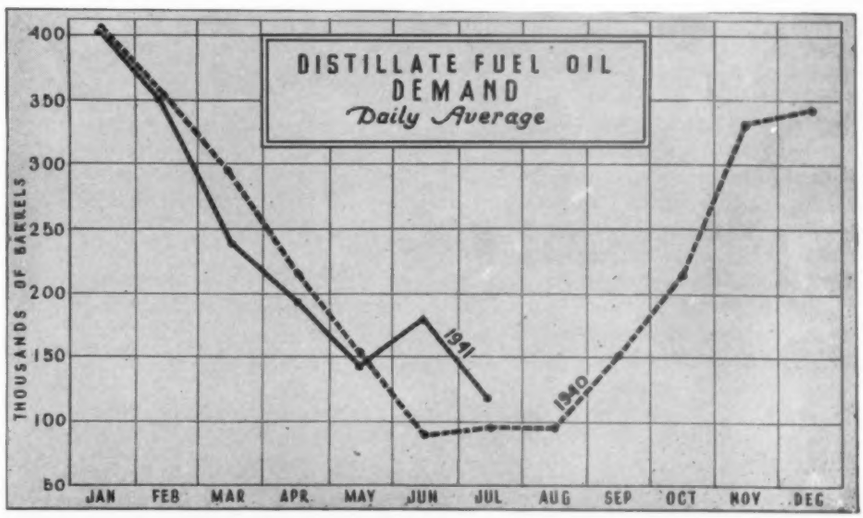


The charts accompanying this article are based on figures released by the Bureau of Mines and the American Petroleum Institute: they apply only to the East Coast area composed of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, District of Columbia, Maryland, West Virginia, Virginia, North and South Carolina, Georgia and Florida.



1941 curve of days supply through August and September might well show an acceleration of this trend, bringing the curve below a point that would be considered safe by the industry engaged in supplying the Eastern Seaboard. Elsewhere in this issue articles deal with the efforts now being made by the oil companies to increase alternative or emergency means of tranpsortation from the refining centers and producing fields of the west to the consuming centers of the east, and with the progress of pipeline construction aimed at the same objective. Every indication from the statistical material available is that such steps are fully justified by the gasoline situation and if vigorously pursued may retard the approach of the Atlantic shortage until spring.

The days supply of distillate fuel oil reveals a relatively satisfactory situation. The leveling off between May and June 1941 compared with the steep increase in 1940 has already been referred to as arising from abnormal causes; such withdrawals are doubtless still in existence and may have a bearing on consumption figures when the heating season starts. In any event it is safe to assume that but little of this fuel oil was actually burned. Days supply of gasoline, however, presents a less satisfactory picture. The trend is steadily downward and has been consistently below that of 1940. Projection of the



Selecting Electric Motors For

PIPELINE SERVICE

By H. E. Dralle

Industry Engineering Dept.
Westinghouse Electric & Manufacturing Co.

THE heaviest consumption of oil products is on the Eastern Seaboard. The principal points of production of these products are in the Southwest, twelve to fifteen hundred miles from the points of use. This condition necessitates the transport of over 1,250,000 bbl. of oil daily by tankers, barges, rail cars, and pipelines from the points of production to the East Coast. Statistics show that about 96 percent of this is moved by tanker from Gulf Coast points to the Eastern Seaboard before this year.

The transfer of American oil tankers to British Service has greatly diminished the facilities for moving oil to the Atlantic Seaboard. In fact, present estimates indicate that with existing rates of consumption, there will be an annual shortage of over 70,000,000 bbl. unless new tankers or other means of transportation are provided. Further possible tanker transfers to other service will merely aggravate the situation.

One of the most logical, immediate, and economic solutions to this possible oil shortage on the East Coast is the construction of pipelines to carry both crude oil and finished products from the Southwest to the points of use. Two gasoline lines are already well under way—the 350 mile Southeastern Pipe Line from Port St. Joe, Florida, to Chattanooga, Tennessee and the 1260 mile Plantation Pipe Line from Baton Rouge, Louisiana to Greensboro, North Carolina. Other and larger pipe lines are under consideration. For each of these, the most economical types of pump drive must be determined.

That each line offers its own peculiar problems in economics is evidenced by the fact that many types of drives are already applied in the more than 300,000 miles of pipeline in this country including engine and electric motor drives.

Where electric power is not readily available, engine driven stations often find successful application, even though their first cost may be from two to three times that of electrically driven stations. Statistics show electric stations to cost approximately $2.00 per barrel of oil handled daily although it must be expected that this figure will vary considerably.

The general acceptance and use of high speed centrifugal pumps in pipeline service necessitates speed-increasing means between engines and pumps. High grade step-up or speed-increasing gear units to step up engine speeds to 3600 rpm pump speeds have played an important part in maintaining the popularity of engine driven stations. In spite of these favorable conditions of application for engines, electrically driven stations are finding ever-expanding use.

Rather than dwell upon such recognized advantages of electrically driven stations as low investment cost, efficiency, dependability, and flexibility of control when compared to other forms of drives, we shall discuss the most popular forms of electric motors, that have found general acceptance in pipeline pumping.

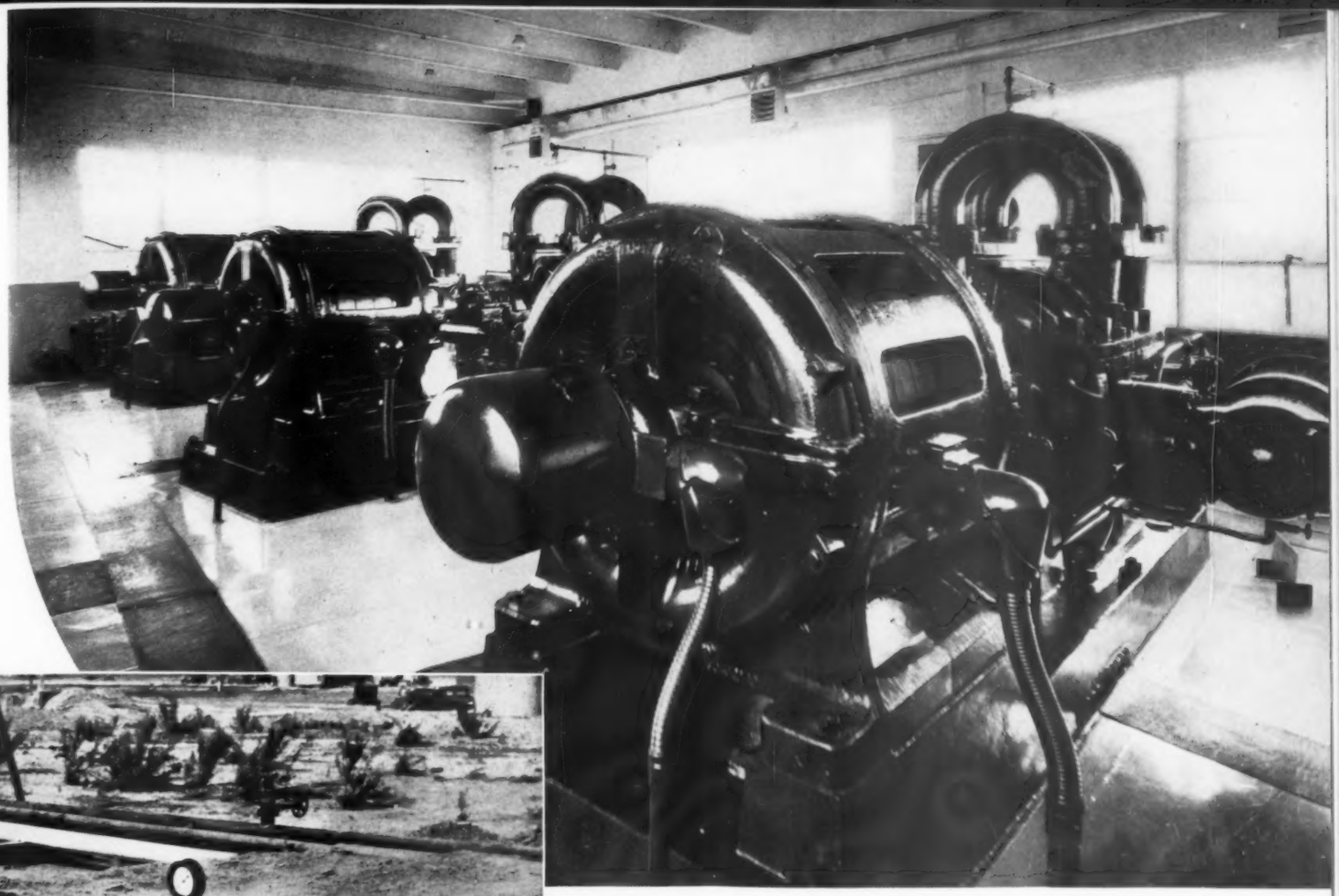
Whether we think of pumps for main trunk lines, gathering lines, terminal loading stations, or booster stations, there are three general types of electric motors that may be used to meet specific operating requirements best. These may be defined and are generally recognized as squirrel cage, synchronous, and wound rotor types, which classify the motors electrically. But these considerations alone are not sufficient. Of equal importance in making correct applications is the mechanical constructions of motors to fit exactly into known requirements for indoor or outdoor service, and for use in hazardous and non-hazardous atmospheres. Thus we see that both electrical characteristics and mechanical construction are fundamentally interdependent.

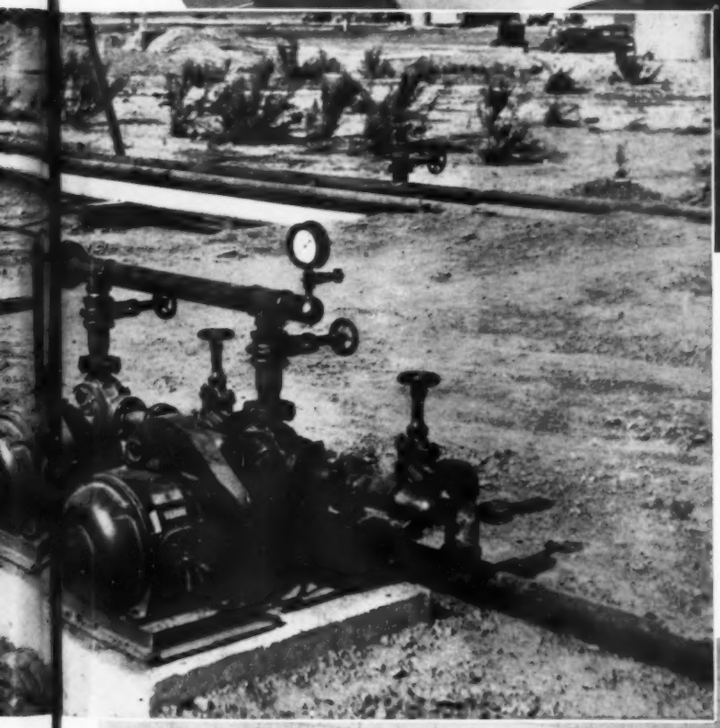
Mechanically, motors are classified by such descriptive and self explanatory terms as open, splash proof, enclosed self-ventilated, enclosed forced ventilated, gas filled, and totally enclosed explosion-resisting. It is noteworthy that these various mechanical constructions are not practically available in all types of motors, a pertinent fact which influences final motor selection in every instance of pipeline selection.

Now let us look at the three types of motors—squirrel cage, wound rotor and synchronous—in conjunction with the aforementioned mechanical constructions, to appreciate better how they individually fit into the pipeline pumping picture.

Squirrel cage motors may be furnished at any speed up to 3600 rpm, for any rating up to 1000 hp at 3600 rpm, and in any of the mechanical designs as listed. This covers the range or requirements for pipeline pumping stations, a fact which coupled with the simplicity of construction, comparatively low first cost, low maintenance, and ease of handling makes the squirrel cage motor the most practical and the most widely used of all types of electric motors in pipeline service. In other words, whether the application be indoors or outdoors, in safe or hazardous atmospheres there is a type of squirrel cage motor to fit the exact operating conditions.

Squirrel cage motors are constant speed types having their most economical application to direct coupled centrifugal pumps operating at speeds between 900 and 3600 rpm. There is no reason why they cannot be supplied with proper torque characteristics and with speed reducers where necessary to drive reciprocating pumps at lower speeds. There are only two limiting conditions which militate against their universal use—one is the relatively large current inrushes at full voltage starting, often necessary to produce required torques for starting their loads, and the necessity for auxiliary means to obtain variable pump outputs. It is not always as economical to use squirrel cage motors and to arrange station units for single, parallel or series operation to



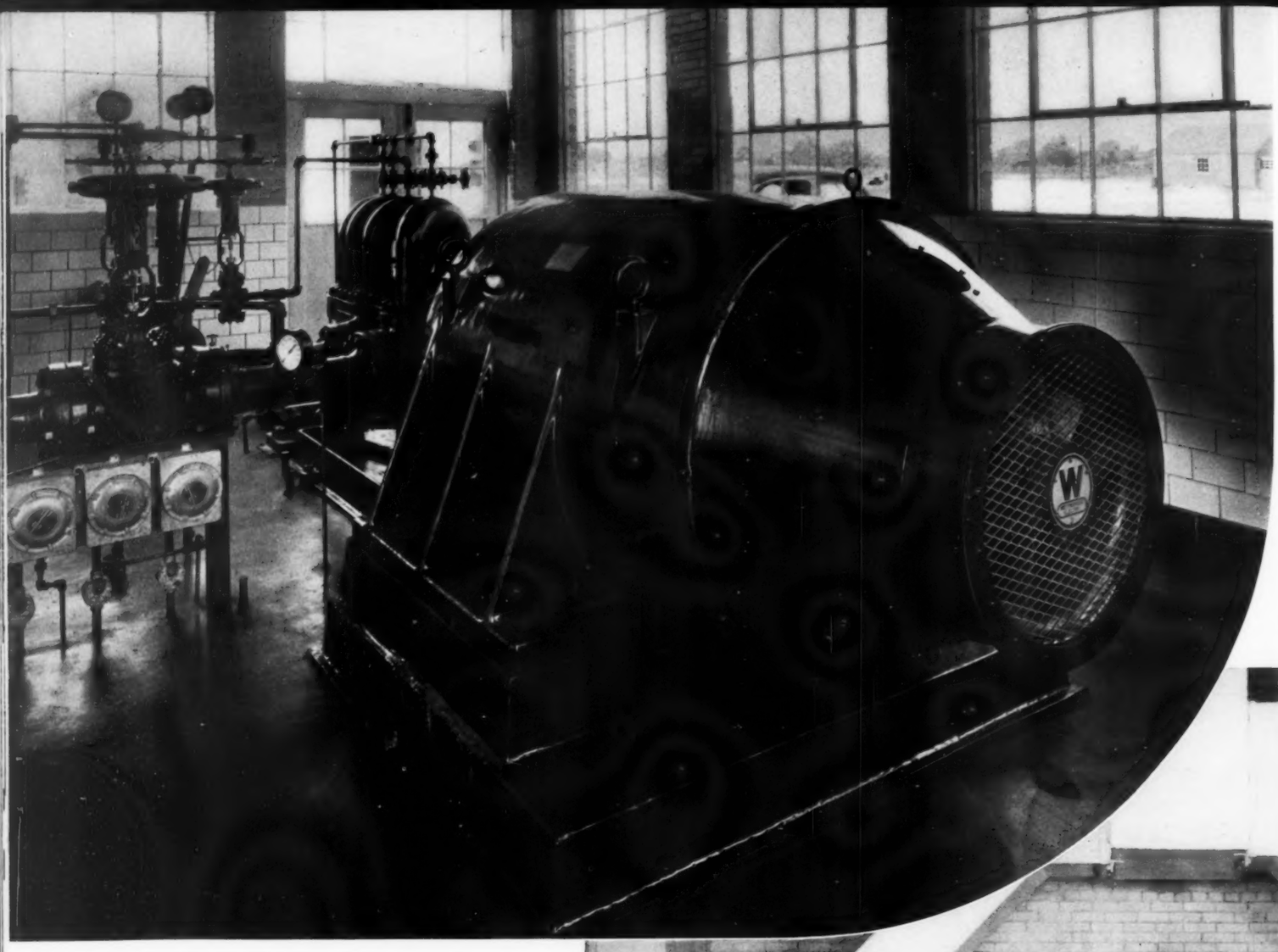


Above, 800 hp. synchronous motors with explosion proof collectors: left, a Westinghouse 300 hp., 300 rpm engine driving a centrifugal pump: and below, operator's room of a modern gasoline pipeline station with control desk at right.

obtain variable line capacities as it is to use motors providing adjustable speed features, especially if lines are run at reduced capacities for an appreciable percentage of their total operating time. The perfection of the hydraulic coupling however, may provide the economical means for furnishing variable pump speeds from a constant speed squirrel cage motor, particularly in ratings 200 hp and above and thus further increase the popularity of the squirrel cage motor.

In main or trunk line pumping stations, either open or splash proof squirrel cage motors may be used irrespective of the product being handled by the line, provided the motors are placed in a well ventilated room separate from the pump and connected to the pump by a shaft extension through the wall, sealed to prevent inflammable or explosive vapors from reaching the motors.

As is generally known, the splash proof motors, as shown in an accompanying illustration applied to a gathering line system, is essentially an open motor, differing mainly in the frame and bracket construction to protect the windings from direct dropping or splashing of liquids, and even from rainfall, although moisture in fine suspension in the air may be carried into the windings. This is neither objectionable nor dangerous as the insulation in splash proof motors is designed to withstand such operating conditions. There is scarcely ever a need for using splash proof motors at slightly higher cost than open motors in fully

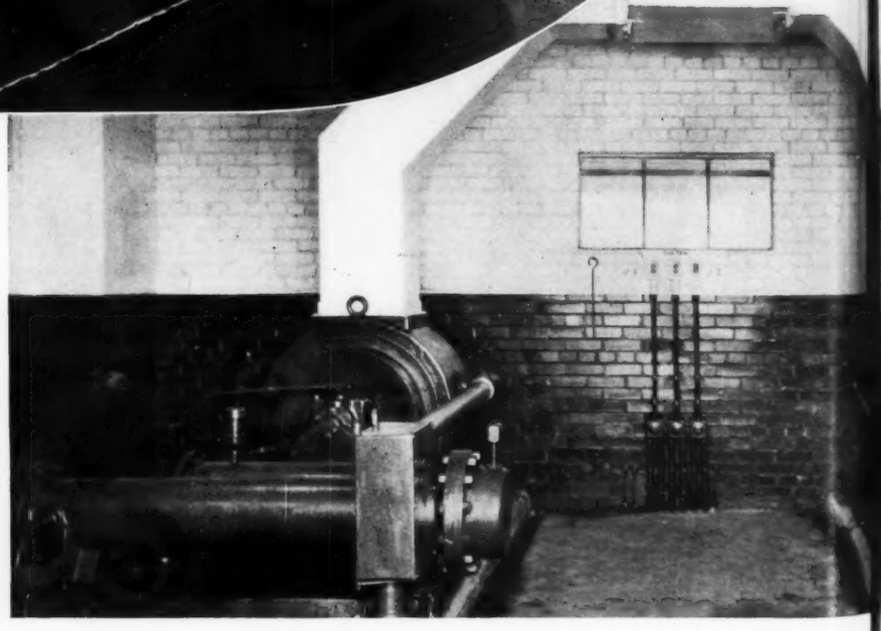


Typical explosion resisting motor installation, duplicate of those to be used on the Plantation Pipeline.

enclosed stations. The main application for splash proof (weatherproof) units is out of doors in non-hazardous locations, such as gathering lines as their use obviates the necessity for protective buildings.

As the names imply, enclosed motors may be of the self ventilated or forced ventilated types. These too, may be used for indoor or outdoor applications in separate rooms where hazardous atmospheres are involved. Or, the forced ventilated type especially may be used directly in hazardous atmospheres if external piping is extended so that inlet ventilating air is brought in from and outlet air expelled to a safe point. Of course, the enclosed self-ventilated motor has definite limitations to the length of piping which can be used. The enclosed self ventilated type motors driving centrifugal pumps is shown in an accompanying illustration.

It must be appreciated that in open, splash proof, and self or forced ventilated, enclosed motors, the ventilating air through the motor comes into direct contact with the windings. In gas filled and explosion resisting motors, this condition does not prevail as air does not reach motor directly.



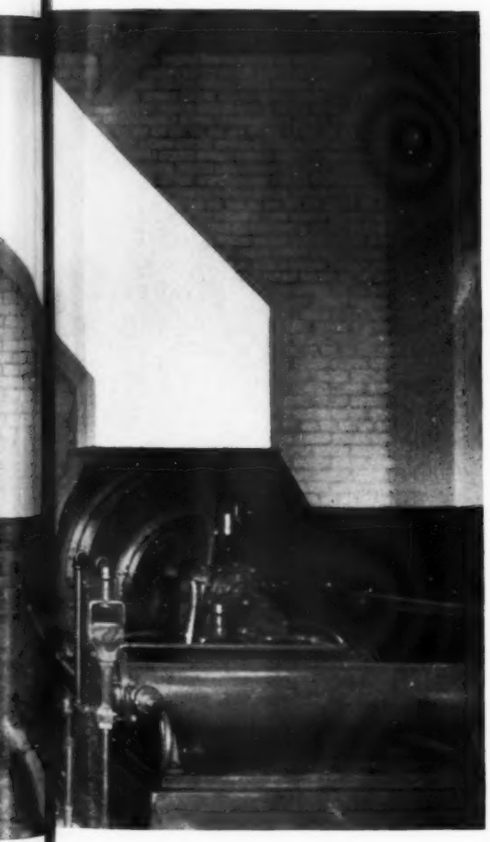
A Westinghouse squirrel cage motor, totally enclosed, of self-ventilated construction, driving pipeline pressure pumps through a fire wall.

Gas filled motors are necessarily totally enclosed. They are filled with a gas which acts as the cooling medium as well as protection to the windings, and is always maintained at a positive differential in pressure with respect to the outside air, obviously making this motor suitable for use in hazardous atmospheres. Heat removal is accomplished by a gas-to-water cooler. The mechanics and complications of the external pressure control systems on such motors, the necessity for maintaining tight fittings, a gas supply, and a water supply make this type of unit much less practical and usable than the totally enclosed, fan cooled, explosion resisting types of motors.

The explosion resisting motor can be safely in-

stalled in the same room with the pump which it drives. Such an application with this type of motor is shown in an accompanying illustration. In this type of construction, outside air does not come in contact with the windings. Air inside the motor is circulated by means of fans on the rotor, through a closed system of ducts which are contiguous to another system of ducts through which an external fan on the motor shaft forces cooling air. The heat from the motor is carried by the inner circulating air, is transferred to and carried away by the external cooling air according to the well-understood, heat-exchanger gas to gas method.

This simply constructed, explosion resisting motor, employing the heat exchanger principle of dual-ventilation bids fair to be the standard for pipeline pumping motors in hazardous locations and is readily available in ratings up to 1000 horsepower at 3600 revolutions per minute.



Explosion resisting motors are naturally more expensive than the other foregoing types mentioned for equivalent horsepower ratings. As the ratings increase over 500 hp at 3600 rpm and 200 hp at 1800 rpm, the comparatively higher initial costs for this type of motor is even more pronounced. In spite of this, the elimination of costly buildings coupled with motor simplicity and ease of installation, their safety, and their utter dependability make this a preferred type of electric motor for pipeline use.

For obtaining variable line through-puts, thought should be given to the economics and practicability of Diesel-electric drives. This form of drive has never received the favorable attention which its possibilities warrant.

Although the predominantly wide application of the squirrel cage type of motor overshadows the possibilities for wound rotor and synchronous types, these latter two will be briefly discussed.

Wound rotor motors find their principal field in application to reciprocating pumps requiring high starting torques, and to centrifugal pumps requiring reduced speeds for variable pump output. They are considerably more costly than squirrel cage motors of similar rating in any type of mechanical construction, but pronouncedly so in explosion resisting construction.

At speeds above 1800 rpm, the construction of these wound rotor motors becomes increasingly difficult. Special rotor banding is required to hold the coils in place, as compared to the practically indestructible squirrel cage rotor. Also there is the difficulty of maintaining brushes and rings. These facts coupled with greater first costs militate against their general usage. The ability to limit starting currents to any desired and pre-determined values, even though starting under load, their slightly higher operating power factors and their ability to operate at reduced speeds, are factors in favor of the wound rotor motor. They do have a place in pipeline pumping but of considerably less importance than the squirrel cage type now so widely used.

Synchronous motors such as the one illustrated find their field of application principally in the low speed fields usually below 900 rpm where the relatively low power factor operation of squirrel cage motors makes the latter undesirable. Even in cases of low speed operation a high speed squirrel cage motor with reduction gear is often found more practical than the use of direct connected slow speed synchronous machines in pipeline pumping operations.

Control for any of these motors may be of the conventional open type for indoor mounting in a separate room; weather proof type for outdoor mounting; or explosion proof for mounting in hazardous locations near the motors. A typical pipeline control room for two pumps each driven by 600 hp, explosion resisting, 2300-volt, 3-phase 60-cycle, 3600 rpm squirred cage motors is shown in an accompanying illustration. This control room is entirely separate from the pump room and is a very acceptable way of mounting electrical controls.

It is of interest that with complete electrical operation it is possible to work out any desired remote, direct, or automatic features of control that are not possible with other forms of prime movers. A control desk with meters all in sight of and within easy reach of the station operator and separate from the motor room has obvious desirable features upon which it is not necessary to elaborate in this brief survey.

In conclusion, it must be said that as each pipeline problem is individually considered the various types of motors discussed will all find application to some extent, but the explosion resisting squirrel cage type will unquestionably be the yardstick by which all other forms of prime movers are measured. With availability of adequate and dependable sources of central station power, it is difficult to foresee anything but a constantly expanding use of explosion resisting squirrel cage motors for the economical operation of pipeline pumping stations.

Competitive Distribution

(Continued from page 26)

pay this additional cost and have the products.

Other illustrations could be given of the economic character of the free enterprise system, i.e., the character which brings about the satisfaction of demand, but mention will be made here of only one other important matter; namely, the economic difference between a general attempt to control the operations of suppliers through a pooling of their facilities and supplies on the one hand; and, on the other hand, the allocation of supplies, i.e., the process of rationing, among consumers. From previous statements, it must be clear that, given freedom, suppliers exert a profound influence upon supply, but that, so long as we labor under a fixed ceiling for prices, consumers have no power whatsoever directly or indirectly to increase supplies. Only in the event of full price freedom under which consumers might be willing to bid up prices could they be said to exert even an indirect influence tending to increase supplies.

In the light of such available facts as have been brought out my opinion is that the government's armed forces will have available supplies of petroleum for every need in unlimited quantities; that there is basis for the belief that there will be little inconvenience to either industrial or civilian consumers in obtaining their full requirements of fuel oils and domestic heating oils; that the need for conservation of transportation by limiting the use of gasoline will pass with the growing results of the industry's efforts to create alternate transportation. Notwithstanding, the psychology of war or of preparation, of the kind now current throughout the country, may require each and every one of us to suffer some form of hardship for the good of our souls and the accomplishment of our major purpose. If this is so, then I am confident that we shall meet the test whether it appear in any other way.

TECHNICAL CONTRIBUTION TO PETROLEUM CONSERVATION

In the early days of the industry with emphasis on increasing production sights such as this burning tank at Glen Pool, Oklahoma, were far more common than today

Technical Advances Have Increased Utility of Reserves Several Fold in Last Two Decades.

By Frederic Penn
Tretolite Company

IN beginning a discussion pertaining to conservation of petroleum, it seems appropriate first to consider briefly the volume of petroleum reserves the conservation of which has caused so much concern in recent years in Washington.

Recent statistics indicate that the proved petroleum reserve of the United States as of January 1, 1941, had reached a new high total of 19,025 million bbl. This increase of 542 million bbl. above the estimated reserves of January 1, 1940, represents the net difference between the total new reserves discovered during 1940 and the volume of crude oil produced during the same time interval. New reserves discovered and developed by the petroleum industry totaled 1,893 million bbl. during 1940. Total volume produced during 1940 was 1,352 million barrels. Strictly interpreted, conservation implies only the efficient production and utilization of reserves already known. In other words, one cannot conserve that which is not yet known to exist. Nevertheless the broader concept of conservation, as it is generally accepted, includes the economical utilization of the known reserves for general industrial use and the important function of continuing to unearth those still hidden reserves that the industry as a whole is conscious still exist in various parts of this country.

In commenting upon the importance of reserves to our economic and military security, a representative of the Navy department has said, "This backlog of producible reserve of oil has gradually accumulated over the past life of the industry as a result of many discoveries each year of relatively shallow (500-1500 ft.) producing areas capable of producing at a slowly diminishing rate over a relatively long period of time. Of late years, however, new discoveries of this type have fallen far below the annual rate of consumption of petroleum and our reserves have been maintained and augmented by discoveries of deep-seated (5000-15,000 ft.) oil horizons, many of which have been found within or adjacent to the known shallow fields. What the life of production from these deep sands will be is not yet known, but it would seem to be beyond question that production from them will be progressively short lived with increased depth.

"In my opinion, such deep production will add materially to the oil reserves of the United States but will not add to the life of the industry, as it is possible that all deep wells will have ceased production due to higher operating costs long before the shallower wells now producing have yielded the last of their recoverable oil."

Important though the matter of drilling and discovering new fields may be, it is not until an oil well is completed and production commenced that the real story of conservation begins.

During the early producing era in Louisiana and Oklahoma (1915 to 1920) wild flowing wells were common. Crude oil was stored in earthen reservoirs. Steam plants for boiling the water out of the oil were in general use, and enormous amounts of crude oil were lost by inefficient producing, storage, and processing methods used at that time in the rush to get production.

In the modern concept of well completion it is usual to consider one or more and sometimes all of the following steps in completing a well efficiently as a preparation for applying the principles of conservation throughout the entire useful life of the well:

1. The setting of one or more strings of casing to prevent the migration of fluids from one formation to another, whether they contain oil and gas, potable waters, or other fluids.

2. The use of electrical logging and sidewall sampling, or other coring devices to investigate thoroughly every possible oil or gas-producing horizon that might have been passed in drilling.

3. The use of the more recently developed

method of gamma-ray logging, either to correlate formations or to determine the success of the cementing operation when cement containing radioactive material has been employed.

4. The use of acid or other chemicals for the various purposes of (a) increasing the porosity of limestones and more recently of sandstones, (b) making the surface tensions of oil and water more nearly comparable so that natural flow can be established more easily, and, (c) for a general cleaning-up of the producing formation to increase the productivity of a well.

5. The scraping of walls or the underreaming of a hole in order to increase the effective area of the producing formation.

6. The use of gravel-packing as a means of combating the tendency of loosely consolidated sand formations to slough-off and fill the well bore.

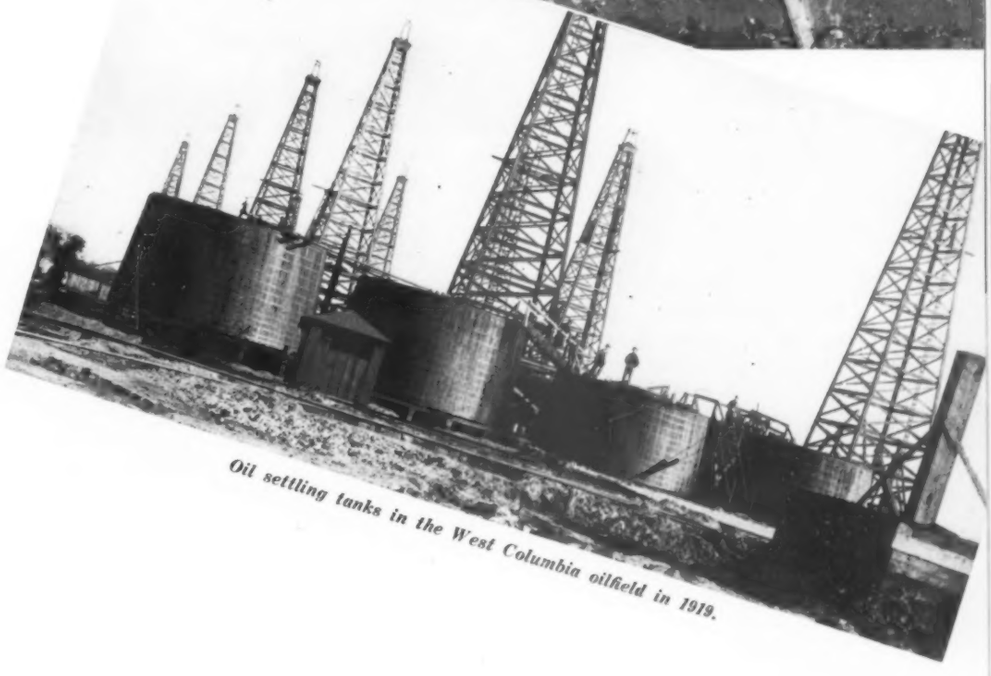
The list could be added to indefinitely if each minor variation were to be mentioned, but the above are examples of the methods coming into use every day, all with the sole objective of increasing the efficiency whereby oil wells are prepared for the all important task of producing oil with as little underground waste as possible.

Referring again to the matter of reserves, one of the most significant developments of recent years has been in the recognition of new factors that vitally affect the calculation of underground reserves of oil and gas. It has been learned that in many fields the pore spaces of the producing formation instead of being filled entirely with oil and gas as formerly believed are now known to contain some quantity of water known as connate water, so termed because it is believed that the water has been present in the formation before and during the time of oil accumulation within the sands. In some instances, the amount of water in the oil sands may amount to as much as 50 percent. It is evident that former calculations of reserves in which this water content was not considered were drastically overstated. Greater attention has been given recently also to the effect solution gas has upon the reserve calculations. At high pressures the liquid may contain considerable volumes of gas that cause the liquid to occupy a greater volume within the reservoir than when the liquid is reduced to lower pressures above ground. As the pressure is reduced the gas comes out of solution thus causing the oil to "shrink" in volume.

The presence of water in an oil-producing formation can be both a help and a hindrance. Full recognition has been given in recent years to the beneficial effect of a natural water drive as a means of exhausting more completely the oil content at lower overall lifting cost. When properly controlled, water can continue to be more beneficial than harmful. In too many instances, however, water is not controlled properly and it becomes necessary to produce greater and greater quantities of water accompanying the oil.

Above, an early example of a small Tret-O-Lite plant on the Big Four lease, Eldorado, Kansas in 1918. Right, before the development of conservation consciousness, Harrell No. 7 in the Caddo field in 1911.

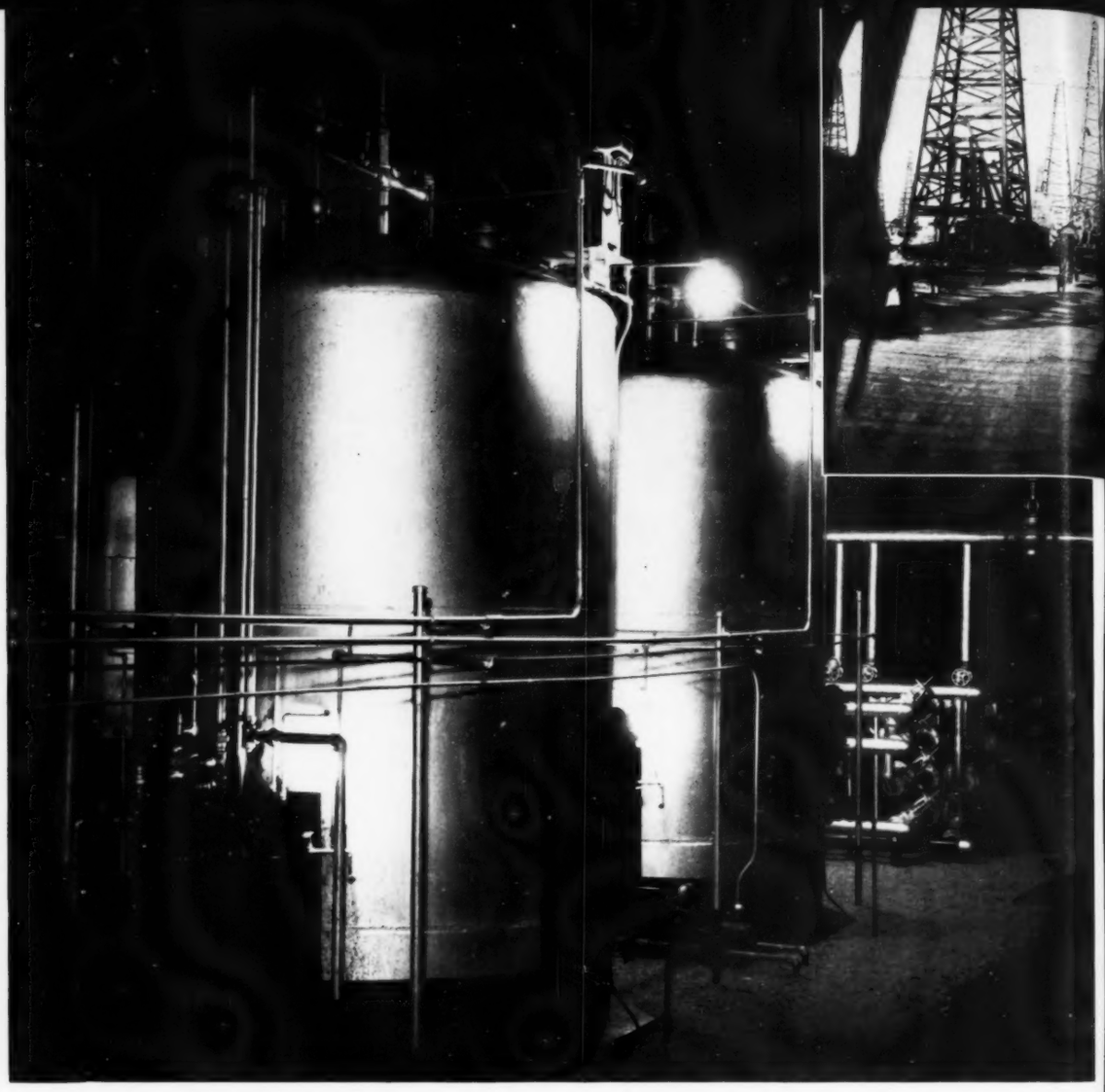
Early methods of treating crude oil: a steam oil treating plant at Norborton, Louisiana in 1913



Oil settling tanks in the West Columbia oilfield in 1919.

Aside from the added costs to the industry of disposing of the large quantities of free water produced in some areas, nearly every operator of a producing well is confronted at one time or another with the need of treating a portion of the oil produced, in order to break down the oil-water emulsions that are produced from the wells in order to get marketable crude.

Emulsions of oil and water are among the most serious causes of waste in the oilfield, and the industry has spent millions of dollars in treating emulsified crude petroleum to obtain marketable oil. Most oilfields have water in the extraneous parts of the reservoir, and during production of oil from the pool the water encroaches upon the oil-bearing structure, eventually reaching the



In contrast to the early wasteful methods pictured elsewhere in this article, a modern electrical crude oil dehydrating plant is pictured at right.

well. Water may enter a well from other sources also—from water-bearing strata above or below the oil-producing sands, or as a result of ineffective water shut-offs, corroded or leaky casing, or drilling into water-bearing sands immediately below the oil zone. When water enters a well from which oil is being produced, mechanical agitation of water with the oil causes dispersion of one liquid in the other to form emulsions (cut oil) creating a problem in effective separation.

Much thought has been given to methods of treating oilfield emulsions, and in consequence of the knowledge gained through continued scientific research substantial improvements have been made in technique in recent years. Outstanding advances have been achieved in formulating chemical-treating agents and in applying electrical methods of dehydrating crude-oil emulsions. These agents and methods and general improvements in the design of plants and the use of automatic controlled devices have increased the efficiency of treating methods and the waste caused by emulsified oil has been eliminated.

The attention of those who proclaim loudest that waste exists in the oil industry is directed to the increased attention being given by more and more oil companies, both large and small, to methods whereby every vestige of the oil and gas brought to the surface may be utilized in some manner. The president of one of the larger companies recently called in the men responsible for the production, pipeline, and refining activities of the company. To these men he issued instructions to examine every phase of the operations under their control and to determine methods whereby every leak could be stopped. He summed up his remarks by saying that it was his belief that the oil industry should, in effect, do as the packing industry has done, namely to utilize every scrap of raw material including "the squeal of the pig." In general these objectives are being attained in the petroleum industry by the use of vapor-tight tanks, by stabilizing crude oil in the field in order to remove those more volatile fractions that are so easily lost by evaporation, and by recovering vapors when their production is otherwise unavoidable.

Perhaps no phase of the oil industry has attracted greater attention in connection with the conservation of petroleum and its more effective utilization than has the refining branch of the industry. Until a few years ago the profit of refining petroleum depended upon the manufacture of straight-run gasoline. The change in demand from straight-run to cracked gasoline has not only pointed the way to more efficient motor-car operation but has had a most drastic effect on petroleum conservation via the route of more efficient extraction of greater yields of gasoline from a given quantity of crude oil. As an example, the effect of the cracking process on the demand for crude petroleum is indicated by the fact that 294 million bbl. of cracked gasoline were manufactured in 1940. If this quantity of gasoline had been of straight-run quality, 1,445 million bbl. of additional crude oil would have been required in addition to the 1,294 million bbl. of crude oil actually processed. In other words, if the greater efficiency of cracking processes were not available, the crude oil consumption necessary to satisfy the ever-increasing demand for motor fuel would be more than doubled and the threat of exhausted petroleum resources would indeed be a cause for great concern. The yield of gasoline from crude oil increased from

The Japhett lease in West Columbia in 1919. A Tret-O-Lite plant has been erected but the cut oil and B. S. had accumulated before the plant started operation.

less than 11 percent in 1909 to about 15 percent in 1914 and to slightly more than 25 percent in 1918. Currently the yield is more than 43 percent and this could be increased if necessary. As indicated above, today's increased demand for gasoline can be met with much less relative increase in the amount of crude oil required, provided the demand for other products does not increase in proportion.

The demand for better gasoline, both for automobiles and for airplanes, has put pressure on refiners to produce motor fuel with ever higher octane rating. Octane specifications first appeared in October, 1931, when a 57-65 octane rating was required for regular-grade gasoline. This was changed in May, 1933, to 60-64 octane; in August, 1934, to 63-70; in April, 1935, to 68-70; in April, 1937, to 67-69 octane. Army airplanes and many air-transport planes now require 100-octane fuel.

The two principal methods open to refiners in earlier days of increasing octane number was by adding lead or by reforming. The loss by reforming or cracking gasoline of 20 to 25 per cent was expensive and was probably the principal reason for the slight decline in yield during recent years. Recently polymerization, alkylation, and catalytic processes have entered the field of manufacture of high-octane fuels. Charging stock for the first two methods is the gas lost in reforming just mentioned. This eliminated the former loss and is another factor in the ever-strengthening position that the oil industry is assuming as the leader in conservation measures.

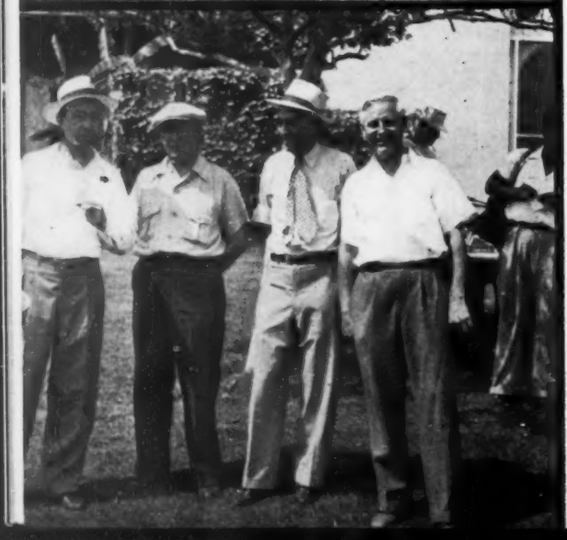
Technical and scientific advances in petroleum refining in the United States have been so rapid and extensive during recent years that it is only with difficulty that those closely affiliated with the industry can keep abreast of the times. The tendency in recent years has been to build continuous units of extremely large capacity capable of yielding a multitude of products of high quality with minimum fuel and labor, and a negligible loss of material. The degree to which this practice has succeeded is indicated by the reductions in price of petroleum products (exclusive of taxes) to the consuming public accompanied by greatly improved quality.

An open pond of bad oil typical of methods used in the early days of the industry. Foreshadowing improved methods is the treating plant in the background.

A greater knowledge of the reactions involved in treating hydrocarbons, the commercial application of catalysis to hydrocarbon reactions, and increased efficiencies and better control of commercial refining processes have been largely responsible for the recent major advances in refining technology. The present commercial applications of the important polymerization process utilize cracking still gases (which formerly were used as refinery fuel or wasted) and natural gases. Other important processes that are affecting the rapidly changing picture of modern refining are: (1) catalytic cracking, (2) alkylation, both thermal and catalytic, (3) hydrogenation, (4) dehydrogenation, (5) cyclization, (6) aromatization, and (7) isomerization. These processes are the outgrowth of recent intensive studies of the chemical reactivity of hydrocarbons predominant in petroleum. All the new refining processes are aids to the progress of conservation of petroleum resources for they not only utilize inferior and ofttimes waste products to produce superior fuels, but the high quality of the resultant fuels permits greater mechanical efficiency in their utilization, thus reducing the volume of raw material required by industry as a source of power or automotive transportation.

The recently developed processes using fixed refinery or still gases as a charging stock in the manufacture of motor fuels are examples of the advances that have been made in petroleum refining in recent years toward conservation of material and disposal of products for more economical uses. Further advances in this direction may be expected as demand increases for high-octane gasoline, chemical products, and other possible by-products of petroleum refining.

In a recent editorial (World Petroleum, February, 1941) the following important statement was made: "It is regrettable that in all the many hearings on oil that are recorded in tomes of published documents the real story of oil conservation has never been told. The truly remarkable record made by the oil industry of its own initiative, through the millions of dollars it spends in research and through its encouragement to men of inventive genius, in improving processes and turning waste material into products of the highest usefulness, is a story of epic achievement more interesting than a romance. This is a story that should be put before the general public which, naturally enough, knows little of the vast expenditure of money and effort that has gone into the conquest of waste, the improvement of products and the reduction of costs, all of which have combined to give the consumers of petroleum products a service that enhances their comfort and efficiency in a score of ways. The real job of conservation is being done by the oil industry itself."



Foreign Oil Legion

CALIFORNIA Chapter of Nomads held their regular September meeting on Wednesday, September 10 in Los Angeles and heard talks by six members recently returned from foreign trips. Henry Pullman spoke on the current trends of importance for the equipment industry in relation to the war and South American development. J. E. Brantly, who has spent much time in South America where he is interested in the Brazilian drilling campaign and in the Ganzo Azul development in Eastern Peru, spoke on the possibilities of wider oil discoveries in South America. Tom Martin gave his impressions of conditions in Trinidad, Venezuela, Colombia, Ecuador and Peru. Roland Smith described present activities in these countries and T. M. Johnston described a number of humorous adventures attending his first trip to Venezuela. Tom Murphy described conditions in Canadian fields. Guests from abroad included Lionel Wiedey of International Petroleum at Talara; Ed Edwards of Standard of Venezuela; E. Swanberg of Ecuadorian Oilfields; W. H. A. Dalton of Shell of Colombia; K. Calvert of Burmah; H. F. Brewen of International in Peru; and S. P. Hart of Mercedes Petroleum in Venezuela.

Scenes at the Annual Golf Tournament and Barbecue of the California Chapter of Nomads held at the Hacienda Country Club and Shell Barbecue Pits during August. Reading from left to right in the top picture: R. E. Smith, K. C. Templeton and T. C. Murphy. In the second picture from the top; Fred Vehlow and E. R. Atkins. Third picture from the top; R. S. Durkee, Jay Curts, Jack Ballagh, and D. G. Miller. Bottom picture shows Charles Schultz, J. E. Pooler, L. E. Hogsett and A. G. Haglund.

T. C. McCobb, director of the Standard Oil Company of New Jersey with Mrs. McCobb sailing from New York aboard the Moore-McCormack liner Brazil on September 13 for a trip to Argentina on business.

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Below, Herbert Henderson, general manager of Gulf Oil Corporation's engineering department, who was recently elected vice-president in charge of engineering of both the Gulf Oil Corporation and Gulf Refining Company. Mr. Henderson has been with the Gulf company since 1907 when he organized the engineering department at Port Arthur, Texas.

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R. W. Parkinson, chief engineer of the Caribbean Petroleum Company (Shell) with Mrs. Parkinson sailing from New York at the end of their vacation on August 29 to return to Maracaibo, Venezuela, where Mr. Parkinson has resided for many years.

JOHN R. SCHMITT was elected president of the Tiona Petroleum Company of Philadelphia on September 22. Mr. Schmitt has been identified with the petroleum industry for twenty-two years having been associated with the Alliance Oil Corporaion of New York as director and treasurer and with the Tide Water Associated Oil Company in its export and domestic marketing departments.

Dr. Rudolph Schider, geologist of the Royal Dutch Shell group, en route to La Guaira, Venezuela aboard the Grace liner Santa Paula sailing from New York on September 5. Dr. Schider expects to be gone about one month on business.

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General Eleazar Lopez Contreras, former president of Venezuela, accompanied by Madame Lopez arrive in New York early in September. General Lopez heads a military mission to the United States for the purpose of arranging purchase of military supplies and to study the progress of North American defense industries. He visited President Roosevelt in Washington and attended a reception in his honor at the Venezuelan Embassy in Washington on September 15 during which he stated that it was his objective to promote military and economic cooperation in the western hemisphere. General and Madame Lopez expect to remain in the United States for two or three months at least. He was succeeded in the Presidency of Venezuela by General Medina Angarita who was inaugurated on May 5th of this year.

COLONEL W. F. ROCKWELL, president of the Pittsburgh Equitable Meter Company and the Merco Nordstrom Valve Company of Pittsburgh, Pa., has been appointed a National Councillor of the Chamber of Commerce of the United States to represent the Association of Gas Appliance and Equipment Manufacturers.

M. E. MONTROSE, vice president and general sales manager of Lane-Wells, has announced that following September 1 all export business of the Lane-Wells Company, formerly handled by John A. Baird of New York will be conducted from the company's general offices at 5610 South Soto Street, Los Angeles, California.

WORLD OIL PRODUCTION

Figures in U. S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries

	U. S. BARRELS				METRIC TONS			
	August 1941 Preliminary	August 1940	Jan.-Aug. 1941	Jan.-Aug. 1940	August 1941 Preliminary	August 1940	Jan.-Aug. 1941	Jan.-Aug. 1940
United States	122,801,850	110,523,000	908,392,750	916,670,500	16,615,052	14,953,727	122,912,629	123,348,785
Soviet Union	16,975,000	21,870,000	170,795,000	161,838,000	2,328,532	3,000,000	23,428,532	22,200,000
Venezuela	19,666,200	15,134,616	139,434,329	129,877,518	2,920,000	2,247,159	20,700,858	19,283,967
Iran	6,596,084	6,700,000	52,035,452	52,491,675	861,220	874,787	6,830,619	6,949,185
Netherlands India: Sumatra	3,500,000	3,456,624	27,095,000	27,206,986	448,086	440,479	3,466,938	3,467,039
Borneo	1,240,000	1,106,080	9,050,400	8,705,992	158,750	141,608	1,158,654	1,114,678
Java	594,000	552,582	4,425,600	4,427,062	76,047	71,114	566,968	560,172
Molucca and Other	62,000	62,310	477,800	490,546	7,938	7,967	61,277	62,759
Rumania	2,926,237	3,864,721	25,850,742	30,091,116	396,778	524,030	3,508,372	4,080,152
Mexico	2,821,000	3,410,000	23,518,000	26,602,787	414,244	500,734	3,453,466	3,829,887
Iraq	800,000	2,000,000	6,700,000	19,725,007	106,938	267,000	895,575	2,637,862
Colombia	2,120,000	2,110,000	15,703,981	17,705,890	295,676	294,281	2,068,894	2,469,436
Trinidad	1,800,000	1,710,000	14,125,000	13,068,566	253,165	240,000	1,986,638	1,837,423
Argentina	1,840,000	1,767,107	14,402,492	13,374,665	262,108	251,724	2,050,215	1,912,344
Peru	1,147,000	1,097,000	8,404,000	8,910,324	151,419	144,818	1,109,337	1,178,243
Bahrein	635,000	622,443	4,899,000	4,890,217	86,654	84,940	668,504	677,477
Burma	660,000	679,520	5,228,040	5,290,445	91,160	93,527	721,775	730 ,263
Canada	847,000	868,651	6,564,969	5,426,813	107,788	110,543	835,330	690,603
Brunei	465,000	487,940	3,713,313	3,840,574	61,056	65,038	493,384	512,126
Great Germany: Old Reich	370,000	384,183	2,972,622	3,223,959	52,910	55,490	425,108	434,870
Ostmark	58,000	61,194	462,959	441,694	8,646	9,700	62,025	76,485
Slovakia & Moravia	9,000	10,106	73,100	79,575	1,326	1,519	10,821	11,956
Poland	232,500	331,421	2,403,900	2,608,656	31,338	44,454	324,009	348,984
Japan	227,300	224,719	1,766,600	1,768,764	32,333	32,085	251,239	252,657
British India	194,515	191,611	1,506,886	1,508,227	26,867	26,443	208,134	208,196
Ecuador	110,934	210,676	1,003,940	1,645,682	14,625	27,775	132,354	216,961
Saudi Arabia	520,000	425,829	3,853,700	3,493,010	70,961	57,685	524,102	473,185
Sarawak	112,000	112,282	872,000	883,785	14,088	14,446	110,909	113,735
Egypt	656,000	475,000	5,100,000	3,678,367	92,831	67,837	728,387	525,327
Italian Empire: Albania	115,000	126,768	930,000	962,020	17,236	19,000	139,391	144,000
Italy	3,800	4,400	30,964	41,350	472	540	3,852	5,110
France	41,000	42,470	316,922	334,398	5,750	5,952	44,449	46,848
Hungary	217,000	170,000	1,579,000	1,035,060	29,194	22,870	212,441	139,225
Bolivia	10,000	10,000	81,106	70,484	1,296	1,394	10,652	8,655
Other Countries	49,500	49,383	386,200	388,797	7,071	7,037	55,092	55,519
WORLD TOTAL	190,416,920	180,377,636	1,464,119,767	1,461,152,489	26,049,557	24,707,766	200,167,982	200,696,181

Official Crude Oil Production Figures from 1938 to 1940

	Daily Averages				Total					
	Bbl.		Metric Tons		Bbl.			Metric Tons		
	Jan.-Aug. 1941	Jan.-Aug. 1940	Jan.-Aug. 1941	Jan.-Aug. 1940	1940	1939	1938	1940	1939	1938
United States	3,732,209	3,728,171	505,813	505,420	1,351,849,500	1,264,962,000	1,214,355,000	182,964,869	171,152,192	164,346,325
Soviet Union	702,860	595,125	96,414	81,293	249,318,000	216,727,024	206,192,000	34,200,000	29,530,168	28,359,000
Venezuela	573,803	538,699	85,189	79,985	184,761,241	205,783,650	188,429,050	27,432,998	30,533,706	27,845,286
Iran	214,138	214,984	28,110	28,518	79,151,675	78,151,332	78,320,840	10,443,546	10,367,117	10,358,495
Netherlands India: Sumatra	111,502	111,504	14,267	14,209	40,586,986	41,557,013	34,538,128	5,172,209	5,320,320	4,662,836
Borneo	37,244	35,680	4,768	4,568	12,987,599	13,125,425	12,812,383	1,662,718	1,680,377	1,719,783
Java	18,212	17,922	2,333	2,296	6,514,462	6,568,714	6,955,283	836,982	842,237	933,595
Molucca and Other	1,966	2,010	252	257	731,746	836,144	607,622	93,569	107,047	81,560
Rumania	106,382	127,988	14,438	17,348	42,524,988	46,020,000	48,366,000	5,766,099	6,240,000	6,603,000
Mexico	96,782	109,027	14,211	15,696	40,314,787	39,428,141	38,505,824	5,843,395	5,794,035	5,716,423
Iraq	27,572	85,302	3,685	11,411	24,225,007	30,791,132	32,404,000	3,238,878	4,115,845	4,345,000
Colombia	64,625	74,555	8,514	10,398	25,592,890	23,857,000	21,521,588	3,569,434	3,327,336	3,007,935
Trinidad	58,128	52,734	8,175	7,416	20,218,566	19,270,256	17,736,176	2,842,918	2,710,515	2,472,943
Argentina	59,270	56,192	8,437	8,004	20,616,928	18,738,003	17,076,237	2,936,880	2,657,232	2,432,857
Peru	34,584	36,886	4,565	4,880	12,985,284	13,587,906	15,908,279	1,716,195	1,798,557	2,099,885
Bahrein	20,160	20,032	2,751	2,735	7,095,370	7,588,554	8,297,998	968,502	1,045,391	1,130,734
Burma	21,515	21,920	2,970	3,017	7,730,901	7,872,981	7,499,498	1,067,895	1,087,424	1,039,960
Canada	27,016	22,275	3,438	2,834	8,718,053	7,837,503	6,965,457	1,109,440	997,487	879,921
Brunei	15,281	15,740	2,030	2,099	5,729,374	5,767,227	5,387,214	764,006	768,320	707,123
Great Germany: Old Reich	12,233	12,393	1,749	1,790	4,543,954	4,487,491	3,850,044	653,590	647,337	552,074
Ostmark	1,905	1,974	255	313	718,494	693,247	370,038	114,045	109,904	63,468
Slovakia & Moravia	301	326	45	49	118,775	119,380	132,005	17,836	18,103	19,282
Poland	9,893	10,691	1,333	1,434	3,891,456	3,898,044	3,828,438	520,984	522,874	504,678
Japan	7,270	7,249	1,034	1,035	2,638,644	2,652,930	2,511,184	376,657	379,161	356,328
British India	6,201	6,181	857	853	2,249,835	2,332,467	2,330,209	310,596	322,160	322,125
Ecuador	4,131	6,744	545	888	2,349,015	2,312,118	2,257,278	309,686	306,824	319,877
Saudi Arabia	15,858	14,315	2,157	1,939	5,364,610	3,933,904	495,135	726,785	536,366	66,683
Sarawak	3,588	3,622	456	466	1,317,185	1,329,645	1,624,882	168,475	171,322	200,126
Egypt	20,988	14,061	2,997	1,912	6,053,367	4,603,797	1,561,231	864,514	657,570	223,058
Italian Empire: Albania	3,827	3,911	574	584	1,497,124	1,393,727	437,597	224,199	208,279	65,313
Italy	127	221	16	28	57,350	91,330	106,083	7,110	11,346	13,178
France	1,304	1,370	183	192	496,420	500,815	516,240	69,578	70,478	72,106
Hungary	6,498	2,951	874	396	1,755,000	815,248	330,829	236,025	109,896	42,798
Bolivia	334	276	44	32	110,484	100,885	106,620	14,249	11,998	13,262
Other Countries	1,589	1,593	227	227	579,997	578,036	243,000	82,779	82,300	34,080
WORLD TOTAL	6,025,184	5,954,229	823,737	813,531	2,175,395,067	2,078,313,069	1,982,639,390	297,267,641	284,241,224	279,111,097

Detailed monthly reports were published in February, 1941 issue.

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr. O. W. Willcox.

OPERATION

Treatment of Oil Sands with Surface-Active Chemicals—C. F. Bonnet, before AMERICAN PETROLEUM INSTITUTE, 11th Mid-Year Meeting, Tulsa, May 1941.

By way of introduction it may be explained that a surface-active chemical is one that lowers the surface tension of water, causing it to flow or spread more extensively.

Oil sands may be treated with surface-active chemicals in order to reduce to a minimum any harmful effects on oil production caused by excess water in the area surrounding a well bore. In planning this treatment, consideration should be given to the physical characteristics of the sand and the effect of pressure differentials upon the flow of the fluids in the sand.

Due to their unique effects on the interfacial relationships between water and sand and water and oil, surface-active chemicals may prove to be valuable tools for correcting abnormally poor production from oil wells.

Composition and structure of surface-active agents greatly influence their effectiveness for various uses. Selection of effective surface-active chemicals requires correct analysis of conditions that prevail in practical use.

Field tests have been conducted under a variety of conditions. Results show that clearcut benefits from the use of surface-active chemicals can be obtained only if the method of field application and the objectives of treatment are selected properly in relation to the importance of surface and mechanical forces in the reservoir.

Factors Affecting the Use of Gravel in Oil Wells Kenneth E. Hill, before DIVISION OF PRODUCTION, A. P. I., 11th Mid-Year meeting, Tulsa, May, 1941.

The use of gravel adjacent to the liners of oil wells is intended to decrease sand production and increase the oil production rate. Gravel packing is an old art in completing water wells, but is relatively new in the oil industry. However, since 1937 several hundreds of wells have been gravel packed, in most cases with notable success in preventing sand from migrating into the well. The author has made a study of the subject and has reached the four conclusions stated below.

1. The largest grains of a gravel to be used for screening unconsolidated sand should bear a diameter ratio of 8 to the diameter of the sand at the 10-percentile cumulative screen analysis.

2. The major increases in production due to gravel packing may be obtained with increases in permeability of the gravel over the formation sand of 20, and with thicknesses of 12 in.

3. The improved production record of gravel-packed and prepacked wells as compared with conventional wells is probably largely due to the possibility of producing them at a larger percentage of their potential capacity. Downtime usually is reduced also.

4. Practical results do not always bear out theoretical and experimental predictions of increased productivity due to gravel packing. This is probably largely due to failure to wash the mud, completely and properly, out of the remote recesses of the gravel and away from the formation walls.

5. It is important to use oil instead of rotary-drilling mud for the placement of a gravel screen in an oil well, in order to obtain the increases in production possible by the presence of the gravel screen around the well.

NATURAL GAS

Operating Results of a Gas Liquefaction Plant —John A. Clark, before NATURAL GAS SECTION, AMERICAN GAS ASSOCIATION, Dallas Meeting, May, 1941.

Following successful development work in a pilot plant, a large-scale works was established at Cleveland to liquefy natural gas and store it for more easily supplying peak demands in excessively cold weather, thus avoiding disappointment to the industrial consumers.

The installation includes spherical storage tanks well insulated with a thick mantle of cork. Gas from the pipe line is compressed and progressively cooled, first by an ammonia circuit, then by an ethylene circuit and finally is liquefied by expanding condensed natural gas; in this way 600 cu. ft. of gas at atmospheric pressure is shrunk to 1 cu. ft. of liquid gas, which represents an enormous reduction in storage volume. The temperature of the stored liquid gas is—260° F. or less. Experience so far gained indicates that one of the storage tanks would not lose by evaporation much more than half its contents in a year. Such evaporation as occurs, is, of course, currently absorbed by the distributing system.

The plant proved its value during several cold spells in the past winter, when pressure in the city distributing systems fell off to an extent that threatened curtailment if not a two-day shutdown of industrial plants. In these emergencies a part of the liquefied gas is regasified and the pressure in the system is maintained. With the return of warmer weather the stock of liquid is replenished.

The plant is designed to liquefy 4,000,000 cu. ft. of gas a day; with present facilities it takes five to seven weeks to build up a supply of liquid equivalent to 150,000,000 cu. ft. of gas.

Total cost of the plant is around $1,250,000, of which $420,000 went for storage spheres and piping. The power requirement is 3,200 HP. Preliminary accounting indicates that for compression and regasification the cost is about 24.4 cents per 1,000 cu. ft. subject to correction at the end of a full year's run.

The author concludes with the observation that a plant of this type is particularly suitable for a company with an increasing demand, a long supply line and a heavy house-heating load. To obtain relief from this situation it would be necessary to have more gas wells and a larger pipe line from the gas-well field; this enlargement of supply becomes unnecessary so long as it is possible to take care of peaks by liquefaction. At any rate, the management feels that the plant has operated successfully in its first year and has fully justified the money invested in it.

PHYSICS

Mud Flow in Drilling—R. J. S. Pigott, before AMERICAN PETROLEUM INSTITUTE, 11th Mid-Year meeting Tulsa, May, 1941.

This paper is a revision of Gulf Research and Development Company's Production Bulletin No. 226, pp. 26-31. New experiments were made which demonstrate that the flow of mud can be predicted in the viscous region by utilizing the variable apparent viscosity in place of the usual constant viscosity for a liquid.

In the turbulent region of flow all plastic effects and, consequently, variation of viscosity disappear; then mud can be treated as a true liquid. Experiments show that in this region the viscosity of mud is surprisingly low. Two different formulas must be used for suspension of cuttings respectively in viscous and turbulent flow with modifications necessary for cuttings other than round particles.

General conclusions are that pressure drop and sustaining effect of any mud can be computed, provided the complete viscosity-velocity relations and the density of mud have been determined first. Raising velocity and density is most useful for lifting. High viscosity either in the viscous or turbulent region is undesirable, as it raises pump pressure in all cases, and in the viscous region is a serious obstacle to dropping cuttings. Gelling to sustain cuttings when circulation is stopped should be obtained by the use of high-gelling materials which, when in motion, do not add materially to the viscosity.

REFINING

Cathodic Protection of Open-Tank Condensers —M. A. Miller, before AMERICAN PETROLEUM INSTITUTE, 11th Mid-Year meeting, Tulsa, May, 1941.

The author here gives what appears to be the first published technical report on cathodic protection of refinery open-tank condensers.

This report concerns four installations in various parts of the country, where corrosion necessitated replacement of the condenser tubes after three to nine months in service, whereas after providing cathodic protection some of these installations are still in good condition after 2½ years.

At the Kendall Refining Co's. plant at Bradford where the total submerged area is approximately 8000 sq. ft., the cost of the anodes and wiring for the installation was estimated by the refiner to be approximately $650. The cost of a copper-oxide weather-proof rectifier rated at 10.5 volts, 78 amperes is approximately $350. The total cost of the unit, therefore, is approximately $1,000 which, when amortized in five years, gives an annual cost of $200. Added to this is the cost of energy which at 1 per cent per kilowatt-hour, will not exceed $60 per year. The total annual cost, therefore, is $260.

The annual cost of replacing coils at Kendall has been approximately $1,000 per year. Therefore, if the cathodic-protection equipment is even moderately effective, it will pay out within a short time.

More data from other installations is needed to establish the economies of the proposition in border line cases.

The Economics of Flue-Gas Recirculation and Economizers in Fired Tubular Heaters in Oil Refineries—C. C. Nelson before AMERICAN PETROLEUM INSTITUTE, 11th Mid-Year meeting, Tulsa, May, 1941.

From observation and 15 years of experience the conclusion is reached that flue-gas recirculation appears to be economically attractive only in the case of existing heaters, which are subject to radiant-section overheating. In the case of new designs there is insufficient advantage to justify the installation of such a system, unless unusually high temperatures are anticipated, and even then there may be preferable alternatives.

Air preheaters, which have been shown to be effective in improving furnace efficiencies, are of doubtful practical utility in ordinary refinery heaters. Experience has indicated that the maintenance and repair costs outweigh the heat savings. At the present low fuel-oil prices, particularly in refineries in the southern part of the United States, the use of air preheaters is even less attractive than formerly.

Any particular installation, of course, must be examined in detail upon its own merit. The above generalizations were drawn from the operation of units which are believed to be fairly typical of those in general use in petroleum refineries. It is, however, entirely possible that differences in fuel quality and cost, along with differences in design and construction costs, may invalidate these conclusions for a particular set of conditions.

Generation of Steam as a Factor in Modern Refinery Heat Economy—Wheaton W. Kraft, Valentine Mekler and Ralph H. Riemenschneider, before AMERICAN PETROLEUM INSTITUTE, 11th Mid-Year Meeting, Tulsa, May, 1941.

This paper calls attention to possibilities of savings in the production of steam for refinery operations. They start from the fact that modern thermal and catalytic processes call for the removal of large amounts of excess heat, and reach the conclusion that using this heat for generating steam offers a simple, flexible and economical solution to the refiner, especially to the refiner who is bothered by unsatisfactory cooling-water and steam conditions.

To show the possibilities in general they consider some typical installations as applied in asphalt distillation, naphtha polyforming, small cracking plants and large combination units, with capacities of 4,000 to 22,000 bbl. a day. Particulars as to how steam is made from these installations are made clear by text and diagram.

Financial details are tabulated as follows:

Economics of steam generation				
Type of Unit	Asphalt Distillation	Naphtha Polyform	Small Cracking	Large Combination Cracking
Extra equipment, $	3,980	32,600	14,250	42,200
Water saved, $	150	420	360	1,680
Value of steam, $	840	11,200	3,400	9,200
Extra fuel, $		1,500	600	
Net return, $	990	10,120	3,160	10,880
Payoff, months	4.0	3.2	4.5	3.9

The savings are given as dollars per month, and the net returns appear quite attractive, especially in view of the short payoff.

The practice is not especially new; it derives its contemporary importance mostly from the increased temperatures and pressures employed in the newer processes, and from perfections in engineering design that now make it relatively easy to save excess heat. While heat saving is here the main theme, the saving in cooling water is not to be overlooked.

The Refiner's Alloy—Weldon L. Archer, in REFINER, Vol. 20 (1941) No. 1, pp. 55-59, 61.

It seems that refining practice in the use of alloys has now mostly come to rest on the use of the 5 per cent chromium alloy, which has appeared to be the most practicable compromise between available extremes. From carbon steel, which gave excellent results within its safe working limits of 950° to 1000° F. while handling "sweet" crudes of Mid-Continent and Eastern fields, the refining industry took a long leap to the 18-8 stainless steels in the search for a longer-lived material. It turned out that these stainless steels were too much of a good thing; they were and still are costly and the equipment in which they were used tended to become obsolescent before the payout. Therefore, a less noble material, one possessing an adequate rather than a long service life, was sought.

Exhaustive tests of the relation between chromium content and rate of corrosion pointed to 5 per cent chromium steel as the answer. Depreciation from corrosion and oxidation was reduced to one-third or one-tenth, and strength at elevated temperatures was increased. This was satisfactory until it was observed that the tubes had a tendency to crack and split after a clean-out. This started another search which led to the 5 per cent chromium 0.5 per cent molybdenum formula which allows an increase of operating temperature to 1100° F. This was all right until it was found desirable to confer better welding qualities on the chromium alloy, and especially to avoid air-hardening. Various metallurgical dodges and addition of other metals were tried; among metals added for this purpose columbium (about 0.5 per cent) has been employed the most extensively. Columbium is especially valuable in pressure units that cannot be annealed after welding.

Thus improved, the many fine qualities of the 5 per cent chromium steel, its moderate cost and its adaptation to many problems encountered in modern oil refining practice entitle it to be called the refiner's alloy.

Service Experience with the New Condenser Tube Alloys—Report of A. S. M. E. Special Research Committee on Condenser Tubes, in A. S. T. M. BULLETIN, May, 1941.

This report is a digest of a questionnaire sent to operators of land and marine surface condensers, and to manufacturers of condenser tubes. Among general conclusions warranted by the answers are the following:

1. Where harbor water, or river water contaminated with sea water, is used for condensing purposes, aluminum brass condenser tubes are being used in increasing amounts, particularly where relatively high velocities through the tubes are used and turbulent water conditions are present in the inlet water boxes.

2. Copper-nickel 70/30 has come to be recognized as showing the best all-around corrosion resistance to salt water aboard naval and other vessels, it having become practically standard for condenser use by the U. S. Navy. However, it does not appear to be the most satisfactory alloy for use in power stations located at tide water and, in particular, using contaminated harbor waters.

3. Admiralty and arsenical copper are continuing to give excellent service in condensers using fresh water.

From experimental data submitted by a company which tested twelve alloys it appears that tubes of annealed aluminum brass are superior to the hard-drawn tubes and, further, that the optimum aluminum content is close to 2.5 per cent. This was noted in contrast to the present-day tendency of American manufacturers to keep the aluminum content at or under 2 per cent. The conclusions are based on the tests reported above and not on service experience.

4. Metals that resist salt water and alkaline water do not resist acid mine water. In a test under actual service conditions an alloy of 88 per cent copper, 10 per cent zinc, 2 per cent tin showed up best of eight alloys tested—better than 70/30 copper-nickel; admiralty; aluminum brass; aluminum bronze; arsenical copper; 70 per cent copper, 29 per cent nickel, 1 per cent tin; and 70.5 per cent copper, 26 per cent zinc, 2 per cent aluminum, 1.5 per cent nickel.

Air Preheaters for Petroleum Heaters—L. A. Mekler and H. A. Becker, before AMERICAN PETROLEUM INSTITUTE, Tulsa meeting, May, 1941.

The petroleum industry consumes the equivalent of approximately 100,000,000 bbl. of fuel per year. Because of ease of handling and response to manual and automatic control, refinery and natural gas represent 50 per cent of the total. Improvement in refinery technique reduced the production of non-salable solid and liquid by-products, and processing of refinery gas to the ultimate may diminish greatly the supply of the gaseous fuels. Fuel savings, therefore, are an economic and operating necessity. Installation of air preheaters may save up to 25 per cent of the fuel used by refinery heaters.

The use of air preheat on a heater designed for cold air does not affect heat distribution materially if the heater is operated at the original capacity. With a given amount of fuel burned, an increase in capacity can be obtained with air preheat if the higher radiant-heat-transfer rates obtained with higher heat liberation and higher flame temperatures due to air preheat are permissible in the heater.

Recuperative preheaters are at present the most commonly used for a wide range of flue-gas and air preheat temperatures. Regenerative preheaters may be more suitable for the highest ranges. The cost of recovering a given portion of heat by air preheat varies inversely with the size of the heater, and passes through an optimum for each heater as the portion of heat recovered is increased.

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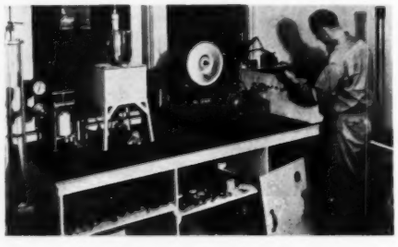
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1940 Road Detonation Tests. Compiled from Report of Cooperative Fuel Research Committee —J. M. Campbell, R. J. Greenshields and Wm. Holaday, before AMERICAN PETROLEUM INSTITUTE, Tulsa meeting, May, 1941.

The 1940 CFR road tests have developed new information that can be used for the development of fuels and engines. Application of the principles worked out in these tests is expected to result in a more efficient utilization of fuel anti-knock properties and more effective engine design and adjustment to meet the requisites of current motor fuels.

These tests indicate that the ASTM octane number alone, or even a road octane number as determined by methods heretofore widely used, does not give sufficient information for present needs relative to fuel behavior in service. Neither do test methods previously used provide sufficient information concerning the fuel requirements and knocking characteristics of engines. The new methods of approach which have been developed furnish needed information relative to the fuel and engine relationship that heretofore has been obscure, and indicate paths for future developments. The new approach arises from a realization that one of the most important factors affecting knock characteristics, which was not taken into account in earlier procedure, is engine speed. As the engine speed at which a given fuel will knock is largely determined by ignition timing the problem has resolved itself into a study of the relationship between ignition timing, engine speed and knocking tendency. When these three factors are considered together, it is found that two fuels which have the same ASTM octane number may show marked differences in performance in relationship to automatic spark advance at low and at high engine speeds.

The Committee outlines several ways in which the octane-number speed relationship may be applied in fuel development and in the interpretation of fuel characteristics; it is believed that a significant new insight has been gained from the 1940 tests which will be applied in the 1941 program.

Evaluation of Diesel Fuels in Full-Scale Engines; Report of Cooperative Fuel Research Committee. —S. G. Ainsley, before AMERICAN PETROLEUM INSTITUTE, Tulsa Meeting, May, 1941.

The CFR Full-Scale Engine Group was organized by engine men representing the major classifications of automotive-type diesel engines. This original group, with the cooperation of the representatives of the petroleum industry, the government agencies, and colleges, has carried on an extensive series of tests on commercial diesel engines. The purpose of the investigation was to determine the influence of fuel properties such as cetane number, viscosity, volatility and gravity on the engine performance.

The requirements recommended for diesel fuels are stated under the heads of viscosity, volatility, flash point, carbon residue, ignition quality, pour point, ash, water and sediment, sulfur and corrosion. Fifteen engines of seven makes were used in these tests.

Viscosity: 33 sec. Saybolt Universal viscosity, i. e., 2.11 centistokes, minimum, and 43 sec. Saybolt Universal viscosity, i. e., 5.22 centistokes, maximum at 100° F., defined by ASTM method D-445-39T and converted to Saybolt Universal viscosity by ASTM D-446-39T.

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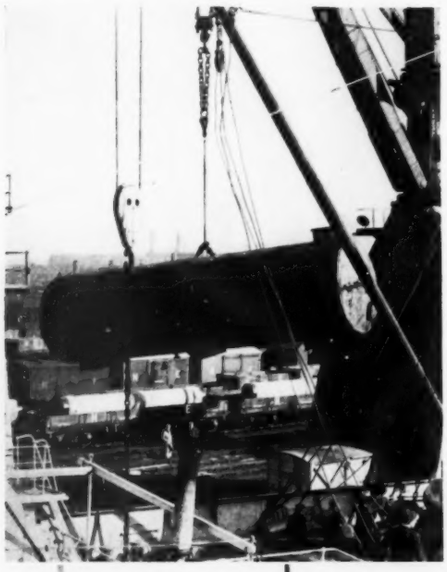

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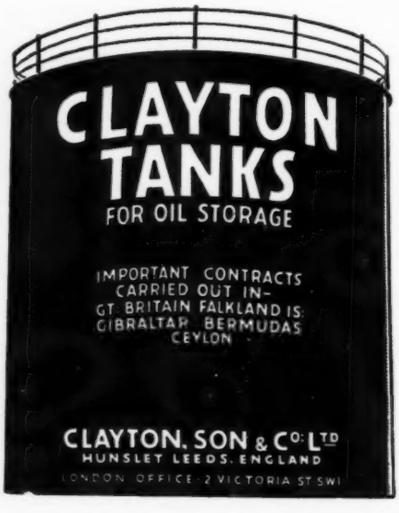

Volatility: to insure minimum smoke odor, lubrication-oil contamination and engine deposits, a 90 per cent point (ASTM) at 650° F. should not be exceeded with end point at 700° maximum (ASTM D-86-35).

Flash Point: Available information indicates that satisfactory operation can be had with fuels with flash points lower than 140° F., which is also a conservative minimum for military fuels.

Carbon Residue: A carbon-residue test on 10 per cent bottoms by ASTM method D-189-39 is considered necessary; performance studies indicate that fuels with a residue not in excess of 0.15 per cent of the 10 per cent residue are satisfactory.

Ignition Quality: Information available on a majority of the engine types used under a wide range of conditions indicates satisfactory performance on fuels of at least 47 cetane number, and this should prove a satisfactory minimum value for a universal military fuel.

Pour Point: It is advisable that a universal fuel for general military use have a pour point of 0 deg. F. As the majority of commercially available fuels have a cloud point approximately 10 deg. F. above the pour point, and as the cloud point limits the flow through the filter, a safe operating temperature for a 0-deg.-F.-pour-point fuel would be +10 deg. F. In those sections of the country where the average daily minimum temperature is below +10 deg. F., it will be necessary to use fuels of correspondingly lower pour point. For other purposes the pour point should not be specified lower than absolutely necessary.

Ash: In view of the carbon-residue limit of 0.15 per cent on 10 per cent bottoms, a special limitation on ash is considered superfluous.

Water and Sediment: The existing limit of 0.05 per cent maximum is satisfactory.

Sulfur: a maximum of 1.0 per cent of ASTM D-129-34 is considered satisfactory from the user's standpoint.

Corrosion: A 3-hour copper strip test at 212° F.; in this test a "peacock" color is considered "tarnish" but not corrosion; a darker color is not acceptable.

Modern Trends in Lubrication—W. H. Oldacre, before WESTERN PETROLEUM REFINERS ASSOCIATION, Hot Springs Meeting, April, 1941.

Explanations as to why a lubricating oil lubricates are of great theoretical interest; the subject has been much illuminated by concepts of polarized oil molecules, surface affinity, adsorption and the like.

However, the practical man is more interested in the good performance of a lubricating oil than in the physico-chemical explanation of normal lubrication. Just now the trend in lubrication progress centers a great deal on how to do away with circumstances that prevent the oil from performing its natural function, or to shield the oil from factors that would give it a harmful character.

This harmful character arises from the fact that under the influence of high operating temperatures the oil generates acids which cause corrosion, lacquers which stick rings, and sludges that clog oil passages, filters, and screens. The oil becomes mixed with iron and other metallic compounds which catalytically change the condition from bad to worse.

To combat these evils there is developing a new branch of science and practice which has to do with "additives," or substances that when added to a lubricating oil will maintain if not increase its desir-

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able qualities. At first these additives were fats of vegetable or animal origin; later on other improvers were found in sulfur, chlorine and phosphorus compounds which depressed pour points and enhanced viscosity index and stringiness. Later still emphasis was placed on oxidation inhibitors which prevented or delayed the formation of corroding acids. While the introduction of solvent refining and better treating has reduced the tendency of oils to form sludge, the engine builders have been canceling this improvemet by increasing loads and using bearing metals that are more senstitive to chemical changes in the oil. The result is that good oils continue to produce sludge which settles in critical locations and causes trouble.

So, in addition to the additives and inhibitors which have been used to prevent sludge in the first place, it has been necessary to invent "detergents" to prevent sludge that is still being formed from settling out; numerous detergents have been invented; metallic soaps and chlorinated soaps have proved satisfactory.

Additives, inhibitors and detergents are bettering the situation as regards engine oils. An annoying problem is presented in the lubrication of bearings, especially since the engine builders have been using sensitive metals and increasing loads and operating temperatures. Some sulfur bearing compounds used as additives have been found that precipitate metallic accelerators and coat the bearings with a protective film of sulfide with surprisingly good results. Even with this progress there is still much to be done.

Mineral Oils as Mosquito Larvicides —H. D. Lord in JOURNAL INSTITUTE PETROLEUM, Vol. 27 (1941), No. 209, pp. 73-93

The first requisite of an oil for use in anti-malarial work is that it shall have a sufficient "spreading pressure" which can be measured by means of an Adam-Langmuir surface pressure apparatus to make an unbroken and effective film when sprayed on water at a rate equivalent to 4 ounces per 100 sq. in. This pressure is around 25 dynes sq. cm. After that, the following conditions should be met:

The film produced must remain stable and effective over a long period. After final evaporation it should not leave permanent residual deposits. The viscosity must be fairly low, so that larval trachea are easily penetrated. The oil must not contain very volatile ingredients which on evaporation will leave the film thick and non-pentrating, or alternatively cause segregation into lenses. Ingredients which either by evaporation or solubility in water affect the stability of the film adversely are to be avoided. The oil should possess true toxic properties, since although these are not technically essential, a quick "kill" of larvæ is likely to prove the best demonstration of its efficacy to the ordinary layman and consumer. It should be non-toxic to fish, birds, animals, and humans. This applies especially to any components which may be soluble in water. The oil should be fairly dark in color so that thin films on water are clearly visible.

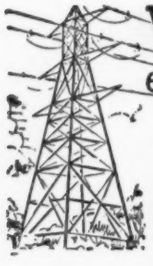
Among various materials examined the best was a residue from a pressure distillate residue boiling in the range 244°-319.5° F., and having a spreading pressure of 27.5 dynes per sq. cm.

Oxygen-Boosting of Diesel Engines for Take-Off —P. H. Sweitzer and E. R. Klinge, in Pennsylvania State College ENGINEERING BULLETIN No. 54 (1941), 27 pages; 50c.

Oxygen has been used in Diesel engines previously but so far as the authors know the full potentialities of oxygen for temporary power boosting have never been explored. They accordingly started a research which ended with these conclusions:

Airplanes require about one third more power during the take-off than in flight. In Diesel-engined airplanes the size of the engine could be reduced by 25 per cent by feeding oxygen into the intake air during the take-off. The results of the experiments are based on 6000 cruising horsepower and an estimated engine weight of 2 lb. per hp.

For the take-off 8000 hp. are necessary. To supply the addition 2000 hp., 200 lb. of oxygen are fed into the intake air during the take-off. The volume of 200 lb. of liquid oxygen is approximately 20 gal. Standard liquid air containers of 55 litre capacity



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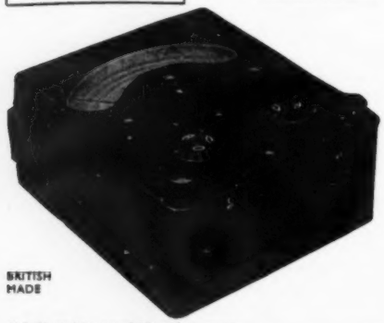

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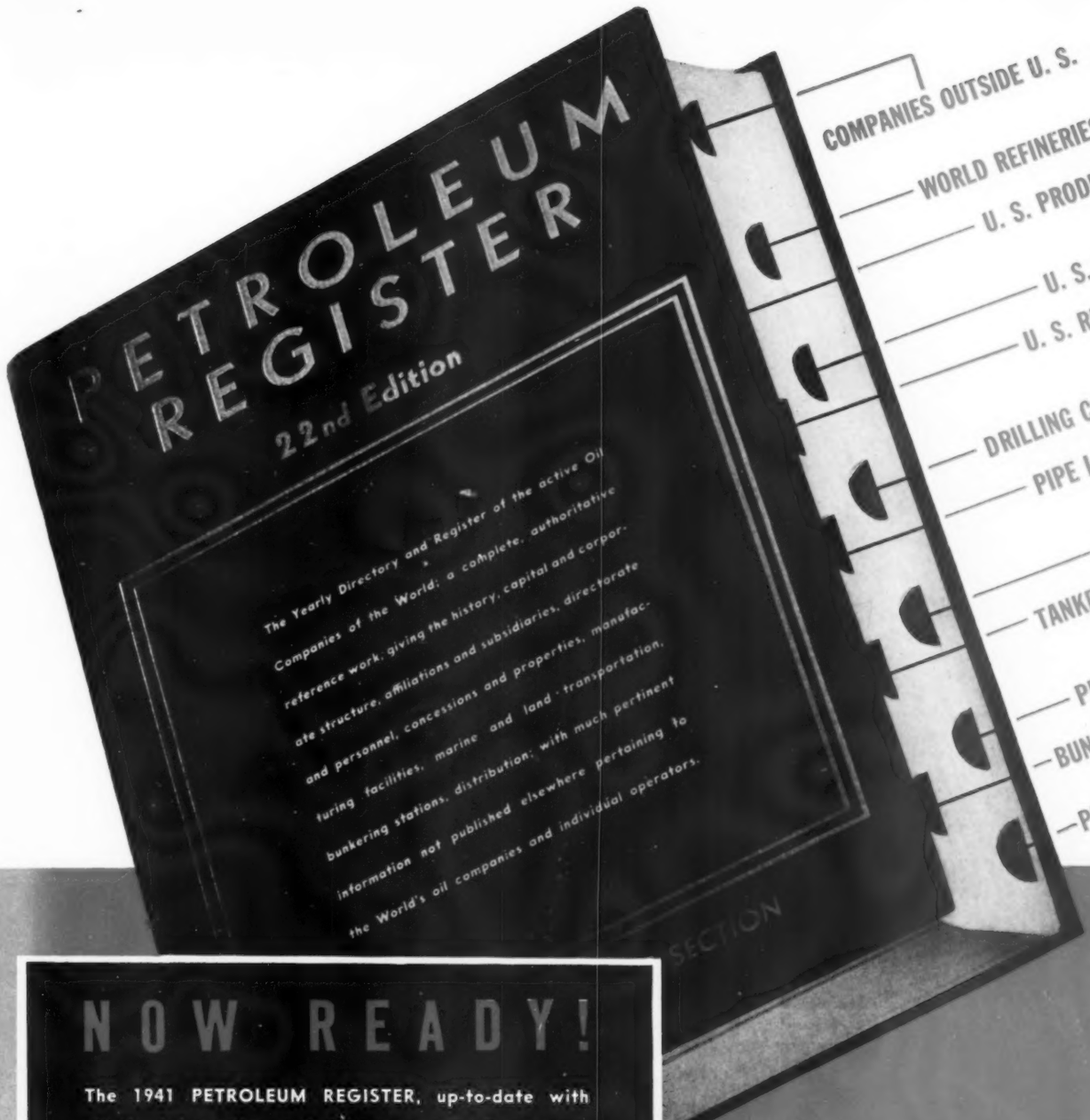
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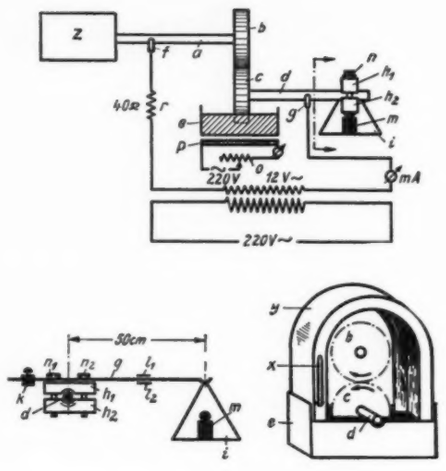
weight 75 lb. Therefore the weight of the oxygen and container is 350 lb. while the possible saving in engine weight is 4000 lb. The weight per take-off horsepower is thereby reduced from 2 to 1.54 lb.

Electrical Measurements on Lubricants for Determining the Danger of Wear—W. Pragst, in OEL UND KOHLE, Vol. 36 (1940) No. 46, pp. 552-557.

The proposed method is based on the following considerations: Lubricating oils and greases are in general good electrical insulators. If there is an effective film of oil between two intermeshing gear wheels of an automobile transmission, a mild electrical circuit cannot be established between the two gears. If a heavy load causes the engaging teeth to rub strongly together the film of oil between them will be more or less reduced in thickness and more or less of a current will pass. If the load becomes great the metal surfaces may make contact and more or less wear will ensue; this point of "danger of wear" will be reached the sooner the higher the working temperature of the oil. It may be reached sooner with one oil than another, which provides a basis for comparing the wear-preventing qualities of different oils.

The accompanying sketch indicates the design of an apparatus for the purpose. A 1 H.P. motor drives the shaft *a* with the gear wheel *b* which meshes with gear wheel *c* on shaft *d;* the lower part of gear *c* dips in oil bath *e*, which may be warmed by an electric hot plate *p*. Part of a 220 volt circuit is transformed to 12 v. and connected at *f* and *g* with the two shafts; this circuit includes a rheostat and milliamperameter. The pressure between the gear teeth can be regulated by weights acting on a Prony grip h_1h_2. The two lower insets of the diagram show



a view of the Prony grip and a housing for the gears. The upper limit of "dry friction" is determined when the unlubricated gear teeth are in contact. Then the gears are lubricated and operated under different loads and temperatures, and the data are recorded in a graph with milliamperes of current passed plotted against loads.

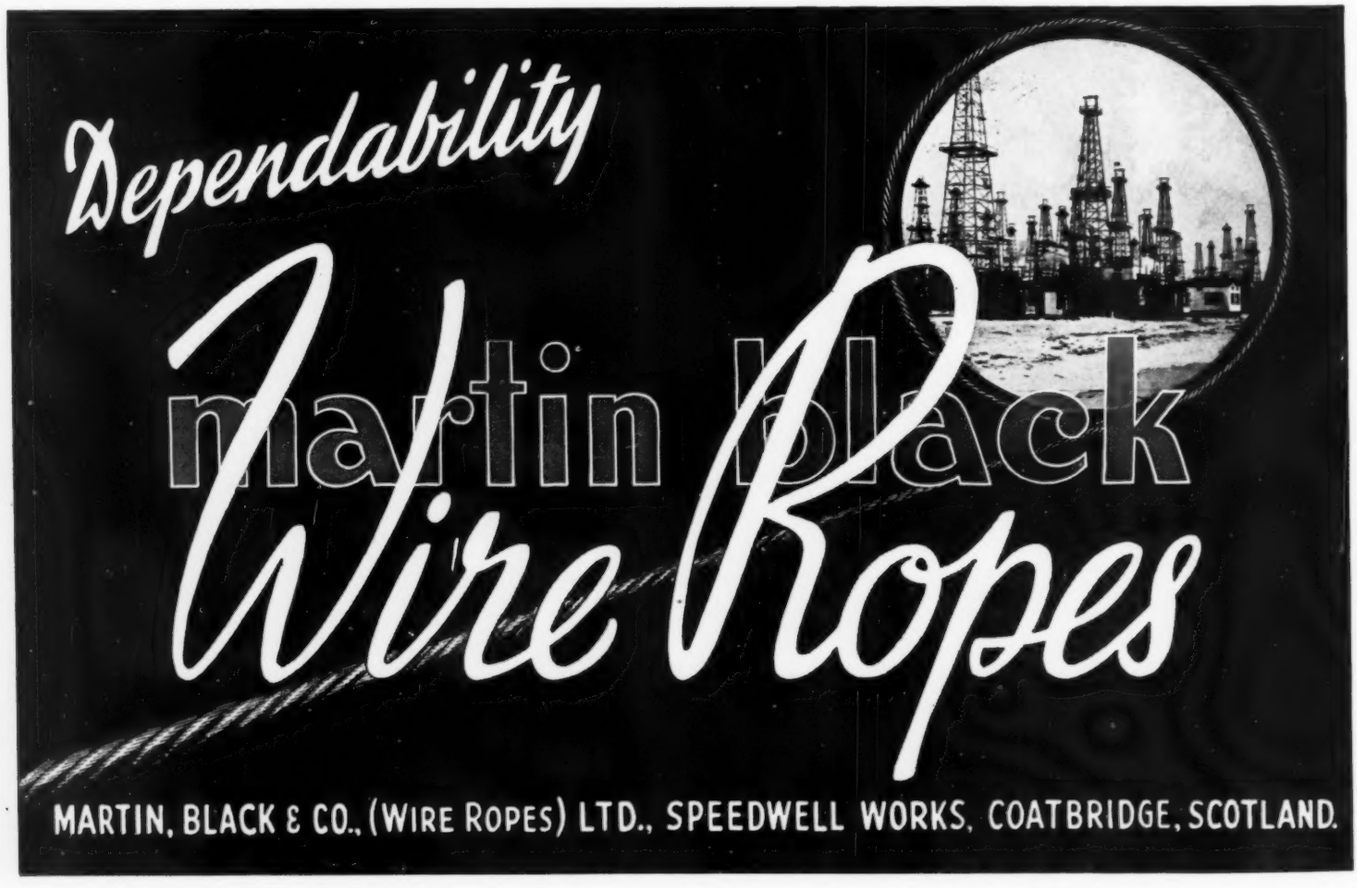
The experimental results are reproducible and can distinguish the wear-preventing value of one oil from that of another. It is also possible to determine the "optimum lubrication" of an oil, that is, the temperature and operating pressure where no current passes, indicating perfect coverage of the metal surfaces. This is the point of "fluid friction." Between this point and the upper limit of "dry friction" is the intermediate zone of "half liquid friction." With this apparatus it is possible to assign numerical values to these three states, which heretofore have been only vague concepts. Various other uses of the method are indicated, including a test for perfect machining of cut gears.

Piston Deposits, Ring Sticking, Varnishing and Ring Clogging—W. A. Gruse and C. J. Livingstone, in JOURNAL INSTITUTE PETROLEUM, vol. 26 (1940), No. 203, pp. 413-429.

The two basic chemical changes in lubricating oils that underlie the formation of engine deposits are (a) the thermal coking of the hydrocarbons under essentially non-oxidizing conditions, and (b) the oxidation of the hydrocarbons. The first is what occurs in the familiar carbon-residue test; the second is the change involved in the Sligh, Indiana, Underwood and the British Air Ministry tests.

The cause of ring-sticking has been obscured in a cloud of controversy, with opinion divided into two camps.

One adheres to the belief that ring-sticking tendency increases with the ease of oxidation of the oil (as indicated by laboratory oxidation tests), whilst the other believes that a volatile oil is best, ease of oxida-



feature of the situation seems to be a large mass of contradictory experimental data. The authors believe this to be due chiefly to the fact that experimenters are using different types of engines under different operating conditions and that the very important mechanical details are being controlled to different extents. Each of the two opinions is undoubtedly sound, depending on the conditions under which it was deduced. Either type of oil is likely to cause or not to cause ring sticking, depending on the conditions.

From their very extensive experimental work the authors connect ring-sticking with oil consumption.

When oil consumption was low, a naphthenic oil left the rings free, whilst a paraffinic oil produced sticking. When oil consumption, on the other hand, was high, the reverse was encountered: the naphthenic oil stuck the rings and the paraffinic left them free.

The explanation of these differences is believed to lie in the variation in behavior of the two oils. At a low rate of flow to the ring grooves the more volatile naphthenic oil apparently vaporized away rapidly enough and cleanly enough so that no appreciable residue of an adhesive nature was left on the rings; the less volatile paraffinic oil, however, at the prevailing temperature, left behind a sticky residuum which accumulated (was probably also oxidized) and finally bound the rings. When the oil flow past the rings was approximately doubled, however, the residue from the paraffinic oil was kept diluted, so that it flowed up rapidly, and thus never had an opportunity of attaining a firmly adhesive condition. The naphthenic oil, by contrast, at a high rate of flow, evaporated only partly; the residue, in the groove evidently then oxidized to a binding cement. This set of phenomena probably represents one of the underlying reasons for the prevailing differences of opinion as to the relative merits of paraffinic and naphthenic oils in reference to ring-sticking. The proponents of naphthenic oils are probably working with engines characterized by low oil consumption as related to piston temperature and output, whilst the proponents of paraffinic oils are perhaps concerned with engines which use more oil in proportion to piston temperature.

SUBSTITUTES

Hydrogenation of High Temperature Tar from By-Product Coke Ovens—H. H. Starch and others, in INDUSTRIAL ENGINEERING CHEMISTRY, vol. 33 (1940), No. 2, pp. 264-274.

After removal of water and valuable tar acids and solvents by distillation at 230 deg. C., coke oven tar was converted to a volatile oil (330 end point) by hydrogenation. The yield on a once-through basis was 80 per cent and gas 20 per cent. The volume yield of liquid was 103 per cent of the topped tar.

About one third of the oil product consists of chemicals that are of industrial importance, including phenol, cresol, benzene, toluene, xylene, tetrahydronaphthalene cyclohexane, etc. Two thirds of the oil product consists of materials boiling in the high-flash naphtha range; this fraction contains large amounts of polymethlbenzenes and polymethyl cyclohexanes.

Among various catalysts used iodoform was found to be the most effective and convenient.

The data obtained show that two phases or stages of hydrogenation are essential: Liquid phase, in which the tar is mixed with a small amount of catalyst and pumped into the converter along with hydrogen under pressure, and the vapor phase, in which the 210-300° C. fraction of the liquid-phase product is vaporized in a stream of hydrogen and passed through a bed of catalyst particles about ⅛ inch in diameter. The temperature and contact time in the liquid phase are about 450° C. and 2 hours, and in the vapor phase, 510° C. and 0.5 minute, respectively.

Power Alcohol, History and Analysis—Arnold Daun, in Report Committee on Motor Fuels, AMERICAN PETROLEUM INSTITUTE, 1941; 58 pages.

The general conclusion reached in this study is that the use in gasoline of alcohol made from farm products is no more practicable today than at the beginning of its consideration thirty years ago. Even cheaply priced farm products cannot be processed into alcohol for less than five to six times the cost of gasoline; a mixture containing 10 per cent of alcohol would consequently cost around 3 cents a gallon more than straight gasoline. Use of a 10 per cet mixture would increase the nation's fuel bill by $690,000,000.

The study states that in net effect the alcohol scheme would be against farm interests because farmers buy one-fourth of the motor fuel consumed, because rela-

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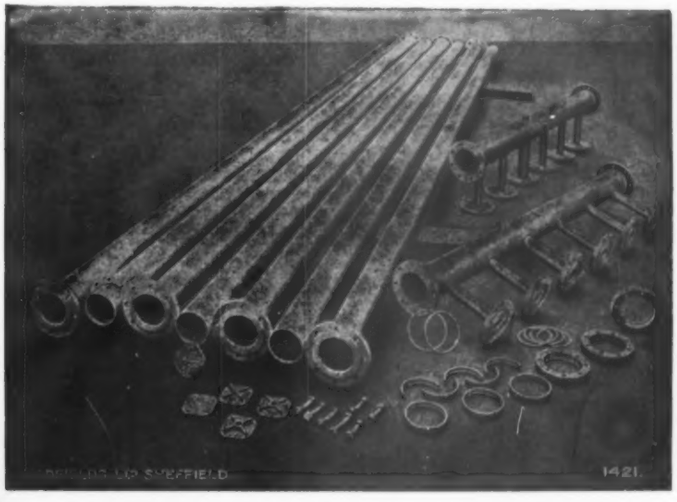

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tively few could actually sell products to alcohol distilleries, and because of adverse influence on sales of other products, on soil fertility, and on independent farming. Introduction of compulsory or subsidized fuels would invite serious disorganization of motor fuel marketing because of unprecedented new opportunities created for evasion of gasoline taxes, which unscrupulous marketers could utilize in waging continuous price wars against honest marketers.

Pretensions that alcohol is needed as a substitute for irreplaceable oil supplies are answered by the fact that petroleum reserves are greater today than ever before, while conservation methods are still improving rapidly. Also, methods already developed of synthesizing oil from coal assure a continuing supply of oil as far into the future as any need can be foreseen, at cheaper prices than are in prospect for alcohol.

World Production of Petroleum Substitutes —V. R. Garfias and R. V. Whetsel, in PETROLEUM TECHNOLOGY, Technical Publication No. 1274. January, 1941; 5 pages.

The world's production of petroleum substitutes in 1939 of which approximately 97 per cent are direct substitutes for motor fuels, is tentatively estimated at 108,000,000 bbl. or equivalent to the combined output of crude oil of Roumania, Mexico and Colombia in 1939. With few exceptions these figures of production also represent actual figures of consumption.

In European countries, particularly in Germany, the imminence of war in 1939 forced an increase in production and in methods of manufacturing substitute motor fuels, largely from coal. In that year Germany produced over 20,000,000 bbl. of these substitutes. The onset of hostilities has greatly stimulated

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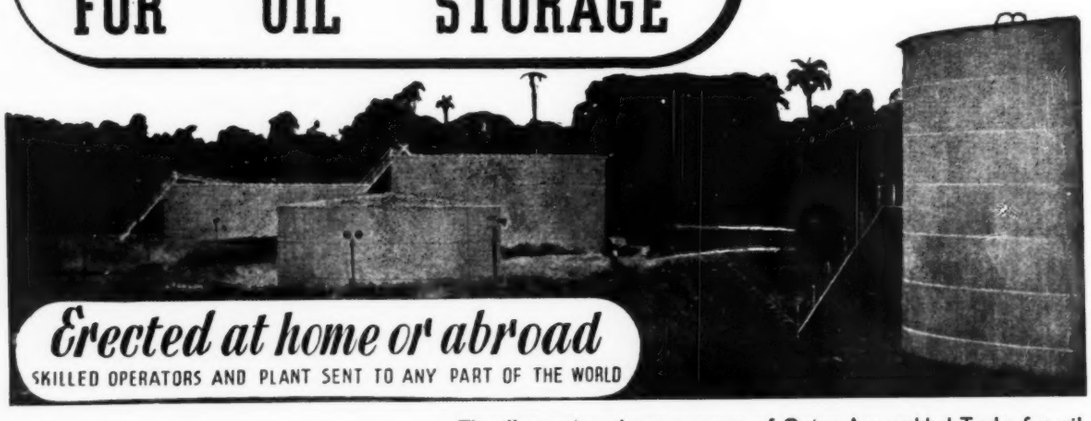

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interest in the matter in some European countries. Production has been stepped up, but probably at least some of this increase has been offset by systematic bombing of synthetic oil plants and storage.

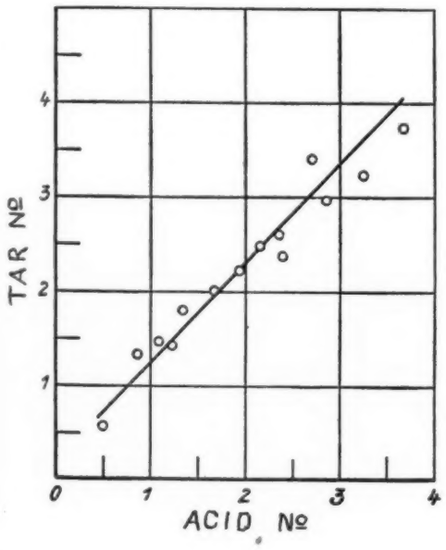
Chief among the petroleum substitutes from coal are gasoline and benzol; the latter is used for blending with lower grade refinery gasoline and sometimes with alcohol. The world's production of alcohol motor fuel in 1939 is estimated at 7,320,000 bbl., of which the United Kingdom produced close to a third. Petroleum substitutes from oil shales aggregated about 2,490,000 bbl., of which Estonia produced about half. Compressed coal gas is extensively used as a motor fuel in Germany.

CHEMISTRY

Analysis of Used Turbine Oils—F. L. Hana, in OIL UND KOHLE, vol. 37 (1941), No. 9, pp. 158-160.

Examination of a large number of used turbine oils disclosed the fact that when the tar-number of the oil is plotted against the acid-number a very close correlation between these two values in found for the range where the acid number is greater than 0.5 and less than 3.5. Within these limits the relation corresponds to a straight line whose equation is: tar-number = 1.05 times acid-number plus 0.2.

The acid number can easily and quickly be determined and the tar number readily calculated. When the acid number of a turbine oil approaches 3.5 sludge formation is imminent. The correlation of the acid-number with the saponification-number is not so close as with the tar-number, and therefore the saponification-number has less diagnostic value.



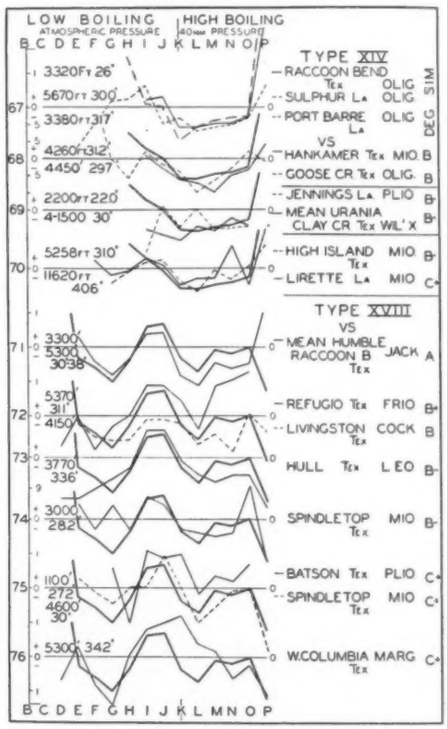
Since the acid number (cc. of tenth-normal sodium hydroxide per gram of oil) is apparently a direct measure of the tar acids; the apparent equivalent weight of the tar acids was found to be 584.

Examination of a used oil that had stood for some time in a vertical container which was not air tight showed that the acid number was different according to the point in the column whence the sample was taken; it was greatest at the top and decreased progressively toward the bottom. This points to the necessity of taking samples while the oil is circulating.

GENERAL

Correlation of Crude Oils on Gulf Coast. Donald C. Bartin, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 25 (1941), No. 4, pp. 561-592.

Discussion of the source and migration of crude oils requires a reliable criterion that will serve to distinguish one crude oil from another. In this paper the author proposes such a criterion, which appears to be found in a "gravity-interval pattern," which is derived from analyses made by the Bureau of Mines Hempel method. In this method a distillation cut is taken at 50° C. and at every 25° C. thereafter up to 275° C. under atmospheric pressure, and at 200° C., and every 25° up to 300° C at a pressure of 40 millimeters of mercury. The A. P. I. gravity of each cut is determined and the interval in degrees A. P. I. is noted; these intervals are averaged and plotted as shown in the accompanying graph. It is found that oils from the same general source give average curves which may differ from the curves found for oils from a different source.



Thus, for example, the graph here reproduced shows characteristic curves of Barton's type XIV, which is an Oligocene crude found from Racoon Bend, Texas to Pt. Barre, La., a distance of nearly 280 miles; evidently, these widely spread crudes have had a common origin. On the other hand, it is seen that the crude of the Frio type XVIII is quite different. This Frio type is the most important Gulf Coast pattern as far as commercial oil is concerned; it occurs over a distance of 150 miles.

There are 24 multi-field types here listed, each of which shows recognizable differences from the others. There are also a number of miscellaneous single-field oils which can be more or less closely related to the major types, and some freakish patterns which point either to exceptional circumstances of origin, or to chemical or physical alterations of their natures

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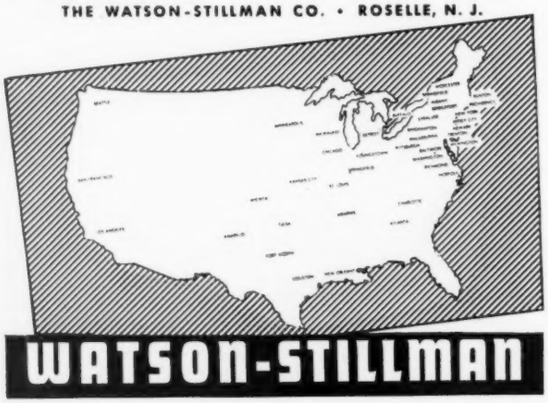

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Sperry-Sun E-C Inclinometer Records Hole Deviation

A NEW INSTRUMENT for recording hole deviation has recently been developed by Sperry-Sun Well Surveying Company of Philadelphia, Pa. and is added to the list of instruments devised for this purpose such as the Surwell Gyroscope, Syfo and the H-K Inclinometers. The new product is named the E-C Inclinometer; this name being derived from the term Electro-Chemical, which is exactly what the E-C instrument is. Operated by dry cell batteries on sound electro-chemical principles, it opens up new possibilities in well surveys.

The E-C Inclinometer cannot produce a false record since no record can be made until the instrument comes to rest at the depth where the information is desired. Another feature is the speed at which the recordings are made. Having no clock, the E-C Inclinometer can be lowered and raised at a speed of 800-1000 feet per minute without damaging the instrument. It has a shorter recording time than any other instrument available. Within 45 seconds after the instrument comes to rest at the desired depth, the record is made and the E-C Inclinometer can be withdrawn or be lowered to other depths for the making of additional records. Several records at various depths can be obtained with one lowering of the instrument simply by varying the time it remains at rest at the different depths. In other words, the longer the period allowed for making the record, the larger is the white dot on the recording disc. 15 seconds is a sufficient differential in recording time to distinguish the readings.

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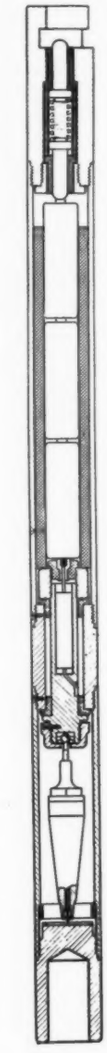
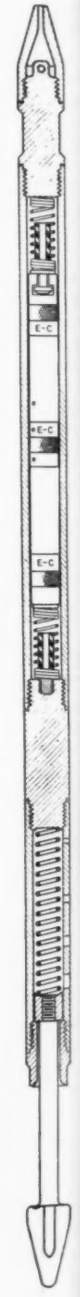
It might be well to add that the E-C Inclinometer is small and compact, the outside diameter of the protective casing being only 1-5/16 inches. It readily passes through a small tool joint.





Far right, cross sections of E-C Inclinometer: Circle at right is an actual size reproduction of the record disc showing recordings at various depths by means of white spots: Below is the carrying case with instrument and supplies.